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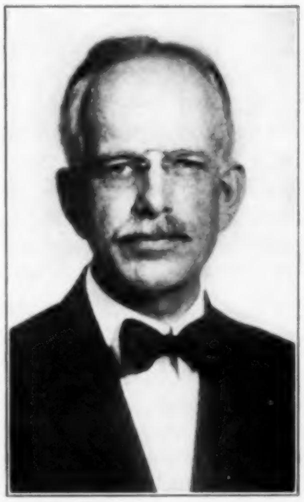
THE NATIONAL ENGINEERING SOCIETIES AND THE NATIONAL RESEARCH COUNCIL

By DR. GEORGE ELLERY HALE,[1] PASADENA, CAL.



Dr. George E. Hale

IN an address delivered in the Engineering Societies Building on May 28, at the kind invitation of the Engineering Foundation, I briefly sketched "The War Activities of the National Research Council." The wide scope of my subject, calling for some reference to the work of the Council in the various branches of the physical and biological sciences, as well as in agriculture, medicine, and other arts, forced me to touch very lightly upon engineering. I therefore beg permission to return to this phase of the subject in the present paper.

As shown in the address just cited, the charter membership of the National Academy of Sciences, constituted in the midst of the Civil War, comprised a notable group of engineers. Indeed, engineering was the only one of the arts represented in the Academy, which based its elections, then as now, upon creative work and original contributions to knowledge. The war was the immediate stimulus that led to the establishment of the Academy, but the published opinions of well-known visitors from abroad indicate that there was urgent need for such a body in this country.

De Tocqueville, in a chapter entitled "How the example of the Americans fails to prove that a democratic people cannot possess aptitude and taste for science, literature and art," wrote in 1840 as follows: "It must be admitted that among the civilized peoples of our time there are few in which the higher sciences have made less progress than in the United States."[2] This he attributed to our Puritan origin, our pursuit of the wealth which is so easily acquired in a new country, and our dependence upon England for intellectual things. "I consider the people of the United States as that portion of the English people which is charged with the exploitation of the forests of the new world, while the rest of the nation, enjoying more leisure and less preoccupied with the material needs of life, may devote itself to thought and to the development of the human mind in every field."[3]

But although he regarded the United States as exceptional, he fancied that he recognized in all democracies conditions of disturbance and unrest which leave little opportunity for the quiet and repose essential to the cultivation of science. These he carefully distinguished, however, from great upheavals of the body politic. "When a violent revolution occurs among a highly civilized people, it cannot fail to give a sudden impulse to feeling and imagination."[4] Thus the French achieved their highest development in science soon after the revolution of 1789.

In 1863, when the National Academy was incorporated, De Tocqueville would probably have considered our intellectual dependence upon England to be materially less than at the time of his visit to the United States, thirty years earlier. Doubtless he would have attributed the improved condition of American science to the effect of the Civil War, and the considerable increase in wealth and leisure. In 1873, if we may judge from Tyndall's remarks in the concluding lecture of his American series, European opinion saw hope for the future of science in the United States, but recognized few important accomplishments. "If great scientific results are not achieved in America, it is not to the small agitations of society that I should be disposed to ascribe the defect, but to the fact that the men among you who possess the endowments necessary for profound scientific inquiry are laden with duties of administration, so heavy as to be utterly incompatible with the continuous and tranquil meditation which original investigation demands."[5] At this time Henry was secretary of the Smithsonian Institution, Barnard was president of Columbia College, and Rogers was president of the Massachusetts Institute of Technology. There was thus some justification for Tyndall's remark, though the amount of scientific research in progress was much larger than one would infer from his statement of the case. Moreover, though deprived by other duties of the privilege of personal work in the laboratory, these very men, charter members of the National Academy, were, nevertheless, laying the foundations of science in America. By uniting in one national body the representatives of research in both science and engineering they set an example which their successors should keep steadily in view.

The half century which elapsed before the United States was again stirred to its depths by another great war was a time of specialization, both at home and abroad. Once fairly launched, both science and the arts made rapid progress, but they inevitably grew apart. Indeed, the tendency toward specialization which divided the arts from the sciences also separated the sciences into many distinct groups and split the arts widely asunder. Thus in engineering many societies were organized, first those comprising the major fields of civil, mechanical, mining and electrical engineering, subsequently those dealing with the special problems of naval architecture, illumination, refrigeration, and still more narrowly limited branches. At the same time numerous major and minor societies were formed in the general field of medicine; others marked out special territories in the name of agriculture, forestry and fisheries; and the process of subdivision and separation still goes on.

It is plain that these effects of specialization, while natural and essential elements in the development of science and the arts, involve certain consequences which are far from advantageous. The underlying motive of the investigator, to advance knowledge and to improve practice through the utilization of new ideas, is common to all fields of action. His point of view is much the same, whether his problems be those of the biologist or the engineer. Moreover—and this is a matter of prime importance—the principles and methods of research developed in one field may be equally applicable in another.

[1] Chairman of The National Research Council. Director, Mt. Wilson Solar Observatory.

[2] De la démocratie en Amérique, 17th ed., vol. 3, p. 58.

[3] Op. cit. p. 60.

[4] Op. cit. p. 70.

[5] Six Lectures on Light, 2nd ed., p. 226.

Thus there is an essential solidarity of research which should bring into active coöperation the men engaged in all of its various branches. Recent experience, both in peace and war, has shown how effectively the physicist and chemist can join forces with the engineer: in fact, how men drawn from the most diverse fields can utilize their varied experience to common advantage.

The remarkable development of engineering in the United States is indicated by the success of the four great national societies, which aggregate more than 30,000 members. Nine-tenths of the work of the engineer is organization and construction rather than research. While the chief interests of the national societies thus lie in other fields, the importance of research is such as to demand a large measure of support from each of them. Moreover, great benefit will result from a joint effort, involving the coöperation of the national engineering societies with the National Academy of Sciences in a new and powerful movement to promote research in every branch of science and the arts. The establishment of the National Research Council, and the duties laid upon it by the President in his recent Executive Order, plainly indicate the steps to be taken.

It is natural that the first effective contact between the National Academy of Sciences and the national engineering societies should have been established through the Engineering Foundation, endowed by Mr. Ambrose Swasey, Past-President Am.Soc.M.E., a mechanical engineer who has contributed greatly to the progress of astronomy through the perfection of the powerful telescopes built by the firm of Warner and Swasey. It is equally natural that the engineers who, with Mr. Swasey, took leading parts in the movement toward a consolidation of interests were also men fitted by experience to appreciate both sides of the question. The National Academy owes a special debt of gratitude to Mr. Gano Dunn, Mem.Am.Soc.M.E., who immediately grasped the purpose in view and has worked unceasingly toward its accomplishment. Though prevented by his heavy responsibilities as a construction engineer from conducting research in a professional way, Mr. Dunn's private activities as an investigator are well known to his friends, who therefore understand how wholeheartedly he has devoted himself to the task of breaking down the artificial barriers between the engineer and the man of science. Others who were most active in the initiation of the movement, including particularly Colonel Carty and Dr. Pupin, also combine experience in research with exceptional capacity as engineers. With their effective aid, and with the active support of the officers of the Engineering Foundation and those of the national societies, the difficulties of the initial steps were soon removed and the way was prepared for the intimate coöperation subsequently realized.

The National Academy, probably because of the general tendency toward separate development of the arts and sciences already mentioned, failed to maintain on its rolls the same percentage of engineers with which it originally set out. At the annual meeting in April 1916, however, the following resolution, presented by the Council, was adopted by the Academy:

> That the Council express to the Academy the opinion that it is desirable that a section of engineering be developed which shall include men who have made original contributions to the science or art of engineering; that to this end the Council suggests to the Academy that the present section of physics and engineering be designated the section of physics, and that the Council, under the authority granted by section 4, article 4, of the constitution, nominate to the Academy, after inviting suggestions from the members of the Academy, two or three engineers each year until such time as it shall seem advisable to establish a separate section of engineering, any engineers elected as the result of such nominations being in the meantime assigned to that one of the existing sections to which their work is most closely related.

Since that time six eminent engineers have been elected to membership in the Academy, and the Section of Engineering will soon be established.

Another means of connection between the Academy and the engineering profession was initiated at the same meeting. Our relations with Germany, after repeated submarine attacks on merchant ships, were in a state of high tension, and the need of some preparation for coming war was plainly evident. The Academy's offer of service to the President was at once accepted, and the National Research Council was formed, at the President's request, for the purpose of federating the research activities of the country.[1]

The first duty laid upon the National Research Council by President Wilson in his Executive Order of May 11, 1918, reads as follows:

> 1 In general, to stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

This definition of the scope of the Council indicates its purpose to give equal attention to research in all branches of science and the arts. The Council fully recognizes the solidarity of research to which reference has already been made, and its efforts will be directed to promoting the closest coöperation between investigators in every field. It should be clearly understood that the National Research Council was not organized as an independent body, but as a means of federating existing research agencies.

War Duties

It is a matter of prime importance that in all researches bearing on the war the scientific and technical societies of the entire country should work in close coöperation, both to avoid unnecessary duplication and to insure the utilization of all ideas and facilities available for the solution of the most difficult problems. The National Research Council affords the necessary means of bringing representatives of these bodies together and into contact with the various technical bureaus of the Army and Navy and other departments of the Government. The advantages afforded by the Research Information Service, and the other facilities for international coöperation provided by the Council, are described below. Here we may observe how some of the work in engineering is conducted.

The appointment of Mr. Gano Dunn as chairman and Dr. W. F. Durand as vice-chairman of the Council's first Engineering Committee insured that its work would be ably directed. Mr. Dunn's engineering duties made it necessary for him to retain his headquarters in New York, but his close contact with the Engineering Foundation and the national societies proved very advantageous. His activities, in fact, led directly to the Council's first step in securing general coöperation in the organization of researches bearing on the submarine problem. In the initiation and development of many other undertakings he played an equally important part. Dr. Durand's joint duties in Washington, as vice-chairman of the Engineering Committee and as chairman of the National Advisory Committee for Aeronautics, gave him opportunity for valuable work in the organization and conduct of many in-

[1] See War Activities of the National Research Council.

vestigations of an engineering nature. When the Research Information Committee was established, Dr. Durand's qualifications for the position of scientific attaché and representative of the Research Council in Paris were so exceptional that he was transferred to this important post.

As a typical illustration of the work of the Engineering Committee, we may mention the organization and activities of the special Sub-Committee on Protective Body Armor, which includes in its membership the curator of arms and armor of the Metropolitan Museum of Art, representatives of the Ordnance Department of the Army, well-known metallurgists, and several able engineers experienced in different fields. The close coöperation of this sub-committee with the Ordnance Department enabled it to carry on its work very effectively, and to make all necessary tests of the special types of helmets and body armor that were devised. The form of the helmet was materially influenced by the extensive knowledge of ancient armor possessed by Dr. (now Major) Bashford Dean, who also went to France to familiarize himself with conditions of trench warfare. The value of this experience has been abundantly proven by the tests to which the helmets have recently been subjected. The metallurgical experiments were carried out in Dr. Howe's own laboratory. The results of the sub-committee's work promise to be of great practical importance in the protection of our troops.

Another illustration of the work of the Engineering Committee, which unfortunately cannot be given in detail because of the confidential nature of the problem, is the development of a special form of gun for the Ordnance Department of the Army. This involved the coöperation of several engineers, machine designers drawn from universities and other organizations, ordnance experts, and manufacturing establishments.

Without going into further details of many other research problems studied by the Engineering Committee, we may now turn to the work of the recently organized Engineering Division, which the natural development of the work of the Research Council has brought into existence. The constantly increasing demands upon Mr. Gano Dunn's time resulting from the large war contracts upon which his firm is engaged, and the departure of Dr. Durand for France, made it necessary to select new officers to carry on the engineering work in Washington. Dr. Henry M. Howe was accordingly made chairman, and Mr. W. J. Lester vice-chairman of the Engineering Division, the purpose of which is described in the following excerpt from the remarks of Dr. Howe at the first meeting of the Advisory Committee of the Division.

After referring to the establishment of the National Research Council, and speaking of its general purposes, Dr. Howe went on to describe the object of the meeting:

It is to consider how we may best carry out this general purpose of "coördinating the scientific resources of the entire country," as regards engineering and how we may best "secure the coöperation of all engineering agencies in which research facilities are available" that you have been called together. We are asked to do something wholly new, and, by the intentional breadth of our charter, we are in effect told to devise ways of doing it. We have a free hand.

Let me tell you what plans we have already made in this early and formative stage of our growth: Our most pressing duty is to help the existing governmental agencies in every possible way to win the war, taking the attitude that, however perfect their several organizations, after all they are finite, that is, limited, whereas the demands which the most rapid possible development of our military strength makes on them are unlimited. We therefore seek and welcome ways of helping them. In general our natural function here has been to develop ideas, often initially nebulous, far enough to make their usefulness clear to the military authorities, using this term broadly to include the land, sea, and air forces, and then to leave the active production to them. In many cases our work is confined strictly to perfecting the design, in other cases models have to be made. In this way the Division of Physics has developed a great number of very important instruments and devices relating to submarine, subterranean, aircraft, and other matters, and the Division of Medicine and Related Sciences, besides organizing many researches in medicine, has developed a system of psychological tests which have been adopted in the Army for both officers and privates.

Our own division has already formed five sections,—on mechanical engineering under Mr. W. J. Lester, prime movers under Prof. Lionel S. Marks, Mem.Am.Soc.M.E., metallurgy under Dr. Bradley Stoughton, Mem.Am.Soc.M.E., electrical engineering under Dr. Stoughton and Prof. C. A. Adams, Mem.Am.Soc.M.E., and military "tanks," and we ask your advice today about forming others on ordnance, clearing house, and the fatigue of metals. The National Advisory Committee for Aeronautics acts as our section on aircraft. Our section on metallurgy has two important committees, on helmets and on body armor under Major Bashford Dean, and on smelting ores of manganese under Mr. J. E. Johnson, Jr., Mem.Am.Soc.M.E.

How we may "secure the coöperation of engineering agencies," as President Wilson wishes, is illustrated first by our working in close coöperation with the Bureaus of Mines and Standards, the latter of which has placed a laboratory at my disposal, and second by our research on the saving of manganese in steel making by replacing it in part with deoxidizing agents.

Here the deoxidizing agents used must bear such a ratio to each other that the sum of the resultant oxides will be fusible at the steel-making temperature, and hence will coalesce and rise to the surface by gravity instead of remaining entangled in the steel to its great harm. But before we can do this we must learn what the fusible combinations of the oxides of available deoxidizing agents are. To this end we have secured the coöperation of the Geophysical Laboratory, whose Dr. R. B. Sosman is one of the first, if not the first, authority on this subject, to select the most promising field, and we are now seeking the coöperation of a large number of laboratories, industrial, educational, and governmental, in determining the actual melting points of large numbers of these combinations of oxides. We thus seek a truly scientific solution of the problem instead of one by trial and error. Here we may have as many as twenty separate institutions collaborating on this one problem, with corresponding saving of time.

It is to be hoped that our present coöperation with the Bureaus of Standards and Mines may be matched by like coöperation with the Naval Consulting Board, whose important work of sifting out the promising inventions from the great mass submitted to it seems to be well complemented by our natural work of developing promising ideas.

Dr. Howe then discussed the question of the men needed and the expenses involved in the proposed work. The Engineering Division of the Research Council already has $30,000 available for its office and organization expenses during the current year, and additional funds will probably become available in the near future.

Since that meeting the work of the Sections on Mechanical Engineering and on Metallurgy has developed rapidly. The former has taken over the laboratories and machine shop of the Carnegie Institution at Pittsburgh so as to control the construction of the devices which it is perfecting. Through its Committee on Fatigue, under the chairmanship of Prof. H. E. Moore of the University of Illinois, it has begun the systematic study of fatigue phenomena, having especially in view the requirements of aircraft crankshafts and welded ship plates. It has brought the development of two special types of guns so far that one is now ready for firing, while the other will probably be fired before this paper is in print. Beyond this it is actively developing ten devices, a special gun for use in aircraft, a special mechanism for controlling it, a new control for aircraft, aircraft fuel, tanks of various types, mechanism for controlling trucks, a new type of tractor, special telescopes, special balloons, parachutes, and a new type of aircraft engine.

The work of the Section on Metallurgy promises to develop chiefly through the creation and direction of committees which shall mobilize the latent skill and patriotism in the metallurgical works themselves and in their laboratories, metallurgical, chemical and mechanical, and in the laboratories of our institutions of learning. Thus in addition to the committees mentioned by Dr. Howe, this Section has organized, under the chairmanship of Col. W. P. Barba of the Ordnance Department, a committee containing the metallurgists of the great ordnance works, Bethlehem, Midvale, Standard and the United States Steel Corporation, to formulate detailed directions for the procedure in making and treating steel ingots for objects needing the very best quality, such as cannon, shells, armor and crankshafts. Under the chairmanship of Dr. George K. Burgess, of the Bureau of Standards, it is now organizing a committee to develop a pyrometer for determining the temperature of the molten steel in the open-hearth and electric steel processes. Other committees with aims of this general class are projected.

Research Information Service

The organization and work of the Research Information Committee, which now has offices in Washington, London, Paris, and Rome, were described in the address previously cited. The subsequent action of the Secretary of War in issuing the following general order to all scientific and technical bureaus of the War Department has led to an important expansion of the work of the Committee.

1 The Secretary of War directs that you be informed as follows:

2 The Research Information Committee was formed to establish machinery by means of which the general staff of the Army, the various bureaus of the Army and Navy, the Scientific Organizations in the United States, who are working on problems connected with war production and invention, and the various committees of the Council of National Defense charged with work of this nature, may be put in touch with the developments and experimental work being carried on, not only in this country, but in Europe, and kept mutually informed of the state of development of work of this nature.

3 In pursuance of the order of the Secretary of War establishing this Committee and in order effectively to do this work, it is vitally necessary that the utmost of cordial coöperation be shown by each of the bureaus and committees in question with the Research Information Committee. To secure this the following is directed:

a All Military Bureaus requiring scientific and technical information are given official status on the Research Information Committee in Washington, D. C.

b Representatives of Military Bureaus or of research committees collecting information abroad will be instructed, by their chiefs, to put themselves into direct relationship with the joint committees of the Research Information Committee sitting in Paris or London, or later in Rome, in order that information be at once dispatched to the Research Information Committee at Washington, D. C. All communications of scientific investigations or research shall be routed through these channels, even though other channels are employed at the same time.

c Official means of intercommunication, such as memoranda, bulletins and the like, between Bureaus of the Army and Committees for research shall be developed to such a degree of efficiency by the Research Information Committee that the distribution of information shall be practically automatic.

d Before sending officers or civilians abroad for investigation work, all Army Bureaus or civilian research committees shall get in touch with the Research Information Committee at Washington, D. C., for information and guidance.

e The present method of routing information memoranda for file and distribution through the Military Intelligence Branch will not be discontinued.

f You will immediately notify this office and the Research Information Committee of the name of the officer who shall represent your Bureau before the Research Information Committee.

By order of the Secretary of War:
(Signed) Paul Giddings, *Adjutant General.*

In accordance with the principles embodied in this order of the Secretary of War, the organization of the Research Information Service has been expanded to include official representatives of all the military and naval bureaus, together with the more important Government civilian bureaus and committees. The present organization of the Washington and foreign offices is given below. A meeting of the Washington representatives was held on August 29, when plans for perfecting the operation of the service were developed.

PRESENT ORGANIZATION OF RESEARCH INFORMATION SERVICE

Committee in Charge:

- The Chief of the Military Intelligence Branch, Brig.-Gen. Marlborough Churchill.
- The Director of Naval Intelligence, Rear-Admiral Roger Welles.
- The Chairman of the National Research Council, who acts as general executive officer of the Information Service.

Washington Branch:

Officers:

- Executive Secretary, Dr. Graham Edgar.
- Representative of Physics and Engineering.
- Representative of Chemistry and Chemical Technology, Dr. Graham Edgar.
- Representative of Medicine and Related Sciences, Dr. R. M. Pearce.

Representatives of Military Bureaus:

- Division of Military Aeronautics, Capt. A. Ames.
- Military Intelligence, Capt. P. M. Buck.
- Bureau of Ordnance, Major C. J. Brown.
- Quartermaster General, Major W. F. Dodd.
- Office of the Signal Corps, Capt. G. F. Gray.
- Chemical Warfare Service, Major S. P. Mulliken.
- Tank Corps, Capt. Phil D. Poston.
- Engineer Corps, Capt. L. D. Rowell.
- Office of Surgeon-General, Col. F. F. Russell.
- Bureau of Aircraft Production.

Representatives of Naval Bureaus:

- Office of Naval Intelligence, Lieut.-Com. H. H. Whittlesey.
- Bureau of Steam Engineering, Lieut. M. Pendleton.
- Bureau of Construction and Repair, Capt. W. G. Du Bose.
- Operations—Aviation, Ensign A. F. Lippmann.
- Bureau of Ordnance, Ensign C. L. McCrea.

Representatives of Civilian Bureaus:

- War Industries Board.
- Bureau of Standards, F. J. Schlink.
- Bureau of Mines, Dr. F. G. Cottrell.
- Bureau of Chemistry, Dr. H. D. Gibbs.
- Explosives Investigations Committee, Dr. C. E. Munroe.
- Nitrate Investigations Committee, Dr. John Johnston.
- National Advisory Committee for Aeronautics, Dr. W. G. Sabine.

Representatives of Foreign Missions

- British Embassy and War Missions.
- French Embassy and War Missions.
- Italian Embassy and War Missions.
- Japanese Embassy and War Missions.
- Canadian War Mission.

London Branch:

- The Military Attaché.
- The Naval Attaché.
- Scientific Attaché, Dr. H. A. Bumstead.
  - Engineering Associate, Dr. S. J. Farnsworth.
  - Chemical Associate.

Paris Branch:

- The Military Attaché.
- The Naval Attaché.

Scientific Attaché, Dr. W. F. Durand.
Physics Associate, Dr. K. T. Compton.
Chemical Associate.
Medical Associate, Dr. R. G. Perkins.

Rome Branch:
The Military Attaché.
The Naval Attaché.
Scientific Attaché, Mr. S. L. G. Knox.
Physics Associate, Dr. Edgar Buckingham.
Chemical Associate, Dr. H. S. Washington.

In this field there will necessarily be close coöperation between the National Research Council and the National Engineering Societies, already well begun through the acceptance of the offer of the American Society of Mechanical Engineers referred to in the address so frequently cited. The policy of the Information Service will be to render available to accredited persons all sources of information relating to research, both at home and abroad. Its chief function at present will relate to the war; but this naturally includes extensive duties of an industrial nature, in addition to more strictly military and naval work. Through the scientific attachés at the various embassies, the Army and Navy Intelligence Services, and the officers of the scientific and technical bureaus of the Government, and through various other agencies with which the National Research Council is in touch, a large collection of valuable information is being brought together and collated for easy reference.

International Coöperation in Research

The work of the Research Information Service, which has already led to the establishment of the position of Scientific Attaché by the State Department, is part of an extensive plan for international coöperation in research which is being developed by the National Academy of Sciences and the National Research Council. A detailed plan for coöperation among the Allies in all researches bearing on the war has been prepared by the Council of the National Academy, for submission at a meeting soon to be held in London, at which the United States will be represented by a delegation appointed by the National Academy.

It is evident that each of the national engineering societies, in addition to its special reasons for securing effective international coöperation in its particular field, has broader interests that necessarily involve joint action with the representatives of other branches of science and the arts. The plan prepared by the National Academy provides a means, through the Section of Foreign Relations of the National Research Council, by which such joint action can be arranged for. While the time is not yet ripe to enter into the details of the scheme, it is worthy of mention here because of its bearing upon the subject of this paper.

Industrial Research

I may conclude this paper with a brief reference to the common interests of the national engineering societies and the National Research Council in the promotion and organization of industrial research, already mentioned in my New York address. The members of the Advisory and Active Committees of the Industrial Relations Section of the National Research Council dined together in New York on May 29. Among the speakers who strongly emphasized the importance of promoting industrial research were Hon. Elihu Root, Mr. Theodore N. Vail, Col. J. J. Carty, Mr. Ambrose Swasey, Dr. Henry S. Pritchett, Mr. Pierre S. duPont, Mr. George Eastman, Mr. Arthur H. Fleming, Dr. L. H. Baekeland, President Richard C. Maclaurin, Dr. M. I. Pupin, and Dr. Willis R. Whitney. Mr. Theodore N. Vail was elected chairman of the Advisory Committee, and it was decided to organize the work of the Section and to begin the publication of a series of bulletins on the value of research and the advantages resulting from the establishment of research laboratories. The Active Committee, of which Dr. John Johnston is chairman, has stimulated the organization of several successful conferences on research in the industries, and the outcome of its work is very promising.

Here is a field where the engineering societies and the Research Council can coöperate to special advantage through the Engineering Foundation, which is already taking an active part. The possibilities of developing this work, through the establishment of special laboratories and by other means, are obvious, and advantage will be taken of the present exceptional opportunity to influence favorably the industries which have hitherto failed to appreciate the value of research.

THE RELATIVE CORROSION OF ALLOYS

By R. B. FEHR,[1] DAYTON, OHIO

In order that the results obtained by different experimenters may be comparable and lead to definite conclusions regarding laws of corrosion, standards should be adopted in regard to such matters as dimensions of specimens, preparation of surfaces, amount of corroding medium, method of suspension in medium, temperature, access of light, duration of test, diffusion, cleaning and weighing of specimen, method of expressing relative corrosion, and, perhaps most important of all, the nature of the corroding medium.

The ultimate aim should be to devise a comprehensive series of tests to which standard specimens of materials may be subjected, and by which the relative corrodibilities of these different materials may be predicted for certain service conditions. A great amount of systematic research work would have to be done before a satisfactory set of standards could be devised, but the problem is somewhat simplified by the fact that relative values of corrosion are desired rather than absolute values. Consequently, it will probably be found that a few tests will cover in a qualitative way the most usual conditions that are met with in practice.

One of the most important factors that would be involved in any proposed standard method is the time element. Al-

[1] Assistant Physicist, Recording and Computing Machine Company. Jun.Am.Soc.M.E.

For presentation at the Annual Meeting, New York, December 3 to 6, 1918, of The American Society of Mechanical Engineers. The paper is here printed in abstract form and advance copies of the complete paper may be obtained by members gratis upon application. The paper will also appear later as Bulletin No. 27 of the Engineering Experiment Station of Pennsylvania. All papers are subject to revision.

though the best test of the usefulness of a material is, of course, the actual service test during a long period of time, no engineer would think of building a machine or structure without first making strength tests of samples of the materials used; and in like manner he would prefer to have some comparatively simple means for determining the relative corrosion of materials before deciding upon the best one to use under the particular conditions involved, without having to wait for the test of time on his completed structure.

To meet this short-time requirement, various so-called "accelerated" corrosion tests have been devised, the principal corroding media being sulphuric acid and sea water or other salt solutions. These methods have met with much opposition for the reason that they do not imitate and therefore cannot intensify natural corrosion influences, as they were intended to do. The results thus obtained are not in agreement with those obtained under practical service conditions. This is not surprising, for it is now becoming generally recognized that the relative corrodibilities of different materials vary with the nature of the corroding media. What may be highly resistant under one set of conditions may be highly corrodible under a different set of conditions.

Since accelerated tests are not regarded as trustworthy, and also since long-time tests are not feasible, it becomes necessary to adopt some compromise between the one- or two-hour period of accelerated tests and the many years of the actual service tests. Some preliminary tests conducted by the writer led to the conclusion that trustworthy results could be obtained within a period of a few weeks, provided analytical balances were employed and the same care exercised as in quantitative chemical analysis. Of course, small test specimens would have to be employed. The objection might be urged that small specimens would not be representative of the material, but duplicate or triplicate samples, combined with greater uniformity of preparation and accuracy in weighing would more than offset this nominal disadvantage.

METHODS PREVIOUSLY EMPLOYED FOR CORROSION TESTS

Not only is it necessary to adopt standard methods of testing, but it is equally important to agree upon some uniform method of expressing the results. The following methods have been employed:

a Loss of weight (specimens of practically the same original weight)

b Per cent loss of weight

c Loss of weight per unit area of exposed surface

d Appearance as judged by the naked eye or lens.

Methods *a*, *b* and *c* are satisfactory if the conditions of testing are exactly the same within experimental limits of accuracy. Methods *a* and *c* do not give correct relative values of the corrodibilities of materials that differ appreciably in density. Method *b* does not have this objection, but like *a* it does not take into account important differences in the ratios of exposed surface to volum . Method *d* is merely qualitative and depends upon personal judgment, but is useful for cases of unequal corrosion, or pitting, as will be noted later.

PROPOSED METHOD FOR INDICATING RELATIVE CORRODIBILITY

Although experiments run under different conditions with respect to weight, density and exposed surface of the specimens can never be considered strictly comparable, a much better measure of the relative corrodibilities of materials can be gained by applying the following method of reasoning:

Suppose, by way of example, that a certain corroding medium gave the results on specimens of different materials having dimensions as noted in Table 1. This example is a somewhat extreme case, but it sometimes requires an extreme case to emphasize a point. A study of the results obtained by the three methods *a*, *b* and *c* is interesting in that they appear to indicate four, three, and two different values, respectively, for the relative corrodibilities, whereas in reality the four materials have the same corrodibility, as further consideration will easily show.

TABLE 1 ILLUSTRATIVE CORROSIVE RESULTS ON DIFFERENT MATERIALS

Specimen	Weight, grams	Volume, c.c.	Surface, sq. cm.	Sq. cm./c.c.	(*a*) Loss, gr.	(*b*) Loss, %	(*c*) Loss, gr./sq.cm.
1	15	3	75	25	1.5	10.0	0.020
2	15	3	150	50	3.0	20.0	0.020
3	30	3	150	50	6.0	20.0	0.040
4	30	3	300	100	12.0	40.0	0.040

What really counts in corrosion is the volume of material removed in a given period of time on each unit of surface, and not the loss in volume per unit of volume, nor the loss in weight per unit of surface, etc., for these latter methods do not take into account the differences in density and exposed surface of the specimens, which differences are certainly no fault of the materials. For instance, specimen No. 2 has the same density, but twice the exposed surface of No. 1. If it were of the same material as No. 1 it would be expected to lose twice the weight, and yet it would be manifestly unfair to say that the relative corrodibilities are different, as indicated by methods *a* and *b*.

Again, No. 3 has twice the density of No. 2, and if it had the same corrodibility it should lose twice the actual weight, as well as twice the weight per unit of surface. Therefore, provided all other conditions were the same in these cases, the only method that would indicate equal corrodibility would be method *b*, on account of the cancelling out of the density factors.

Obviously, then, none of the methods employed thus far indicates the true relative corrosion values for specimens of different sizes from different materials. However, if the results obtained by method *b* in Table 1 are divided by the respective values for the ratio of surface to volume, the results will be 0.40 in each case, and thus a true measure of the relative corrodibility is obtained.

The algebraic derivation of this method is as follows:

Let a = area of *exposed* surface of test specimen, sq. cm.
v = volume of specimen, cu. cm.
d = density of material, grams per cu. cm.
w = original weight of specimen, grams
s = loss in weight in grams by method (a)
p = per cent loss in weight by method (b)
K = relative corrosion by proposed method, per cent of cu. cm. per sq. cm. of surface.

$$p = \frac{s}{w} \times 100$$

$$= 100\,\frac{\frac{s}{d}}{\frac{w}{d}} = 100\,\frac{\frac{s}{d}}{v} = \text{per cent loss of volume,}$$

since the volume equals weight divided by density.

$$\frac{a}{v} = \text{ratio of surface to volume,}$$

and

$$\frac{p}{\frac{a}{v}} = 100\,\frac{\frac{s}{d}}{v} \times \frac{v}{a} = 100\,\frac{\frac{s}{d}}{a} = \text{per cent of cu. cm. lost per}$$

sq. cm. of surface. Therefore,

$$K = \frac{p}{\frac{a}{v}}$$

that is, the per cent loss in weight is to be divided by the ratio of surface to volume.

These values of K will then represent the true relative corrodibilities when the conditions of testing are the same except for the densities and dimensions of the specimens. But finally, in order to express in the simplest and most easily comprehended manner the relative values of different materials in regard to their *resistances to corrosion,* the reciprocals of the K values should be taken and compared with, say, the highest one which, for the sake of comparison, may be regarded as having a corrosion resistance of 100 per cent. Thus, if materials *A, B, C,* and *D* have values for K of 5, 10, 15, 20, respectively, the reciprocals or resistances to corrosion will be 0.2, 0.1, 0.067, and 0.05, while the relative "efficiencies" of resistance to corrosion will be 100, 50, 33⅓, and 25, respectively.

This new method of expressing relative corrodibilities takes into account the obvious fact that corrosion varies directly as the exposed surface, other things being equal. The time element cannot be involved in any method of expressing corrosion, for it is a well-established fact that corrosion does not vary directly as the time, since the first layers of corrosion products may in some cases inhibit, and in other cases, accelerate, corrosion. In other words, the duration of all tests that are to yield comparative results should be a constant quantity.

A Series of Comparative Corrosion Tests

It is believed by the writer that careful tests of different sizes of specimens of various kinds of materials run under like conditions will justify the above proposed method of expressing the results, but as yet no such series of tests can be offered. Nevertheless, it may be of interest to report the results of a series of tests that were run for the purpose of ascertaining the consistency of results that could be obtained by exposing small-size specimens to tap water and solutions of sea salt for comparatively short periods of time. These tests are to be regarded as preliminary, and therefore the arbitrary conditions adopted will be subject to such future modifications or drastic changes as inconsistencies in results of these and succeeding series of tests may indicate.

A number of commercial alloys were supplied by various manufacturers who were interested in seeing a series of tests run by experimenters who had no interest in any industrial concern. The analyses of these alloys, as made by the manufacturers, are found in Table 2.

The alloys were supplied in the form of ¾-in. rolled stock, which was turned down in a lathe, and from which were cut disks of fairly uniform size. A ⅛-in. hole was drilled in the center of each specimen in order that a glass hook could be inserted for suspending the specimen in the corroding medium. All the specimens were first roughly polished by emery cloth and then finished to uniform surface conditions by rouge cloth. The disks were then washed in ether to remove all grease, dried in a dessicator, and carefully weighed on analytical balances.

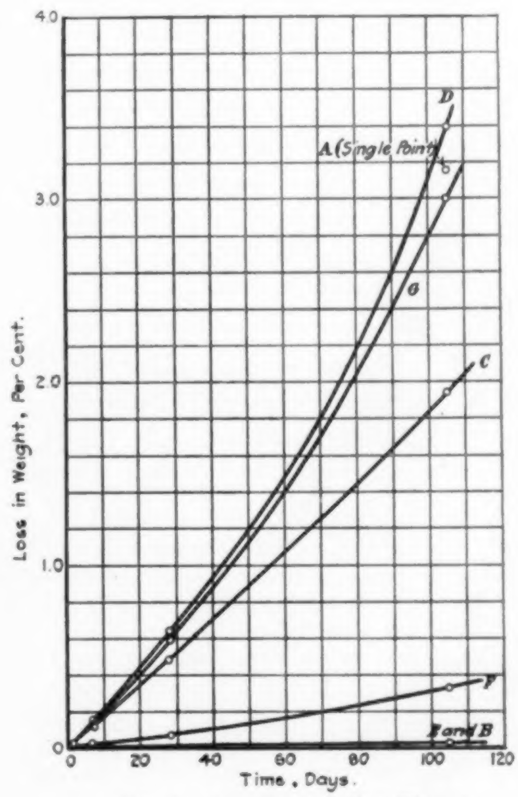


Fig. 1 Corrosion in Tap Water

The following solutions were employed:

1 Tap water
2 0.1 per cent sea-salt solution (one gram of sea salt per liter of tap water)
3 10 per cent sea-salt solution (100 grams of sea salt per liter of tap water).

TABLE 2 ANALYSES OF ALLOYS

	A	*B*	*C*	*D*	*E*	*F*	*G*
	Percentages						
Fe	99.84	2.30	98.473	98.697	Trace	67.406	99.647
C	0.01	...	0.78	0.459	...	0.19	0.04
Mn	0.025	1½–1¾	0.594	0.74	...	1.35	0.26
Si	0.005	...	0.065	0.06	...	0.184	0.01
S	0.025	...	0.055	0.035	...	S and P less than 0.04	0.036
P	0.005	...	0.013	0.009	...		0.007
Cu	0.05	30.02	...	...	89.84	...	...
Ni	...	65.48	...	...	...	30.83	...
Al	...	...	...	...	9.96	...	...
Ti	...	...	0.02	...	...	...	...

The tests on the various alloys and three solutions were run simultaneously with duplicate specimens. A 150-c.c. beaker filled with 100 c.c. of the corroding solution was provided for each individual specimen, which was suspended in the middle

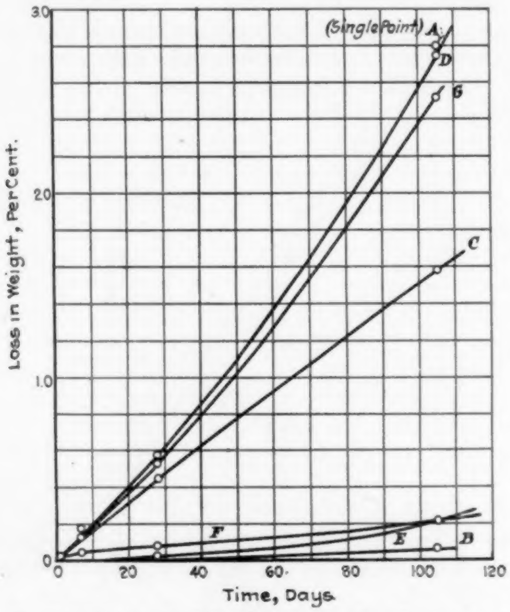


FIG. 2 CORROSION IN 0.10 PER CENT SEA-SALT SOLUTION

of the solution by means of a glass hook attached to a short piece of wood resting on top of the beaker. At the end of the one-day (24-hour) test the specimens were removed from the beakers, soaked for several hours in a solution of ammonium citrate in order to remove the rust, dried and carefully weighed to determine the loss in weight. The specimens were then polished so as to have new surfaces, cleaned, dried and weighed for the succeeding seven-day test, for which new solutions were employed. This procedure was maintained for

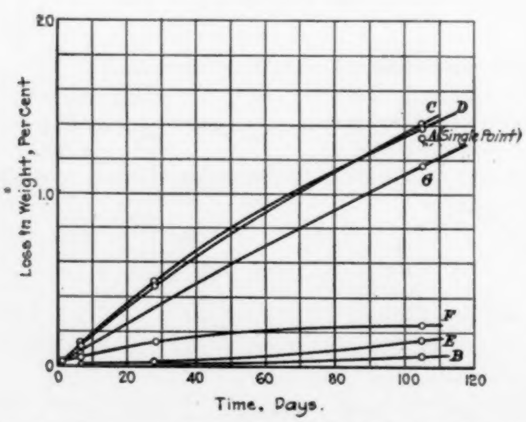


FIG. 3 CORROSION IN 10 PER CENT SEA-SALT SOLUTION

the 28- and 105-day tests. In all cases the beakers were placed in a glass case, and the daily maximum and minimum temperatures were observed.

RESULTS

In expressing the results of these tests, the percentages of loss by weight were plotted in Figs. 1, 2 and 3, rather than the values of K as proposed above, for the reason that the ratios of the surface to volume were practically the same, the average deviation from the mean being only 4.6 per cent. In Figs. 4, 5 and 6 are plotted the relative efficiencies of resistance to corrosion as previously explained in this paper, the alloy marked F being taken as the 100 per cent standard in this case. Alloys B and E exhibited such a slight amount of corrosion that they could not very well be used as a basis for comparison.

Among the points to be noted as a result of these tests are the following:

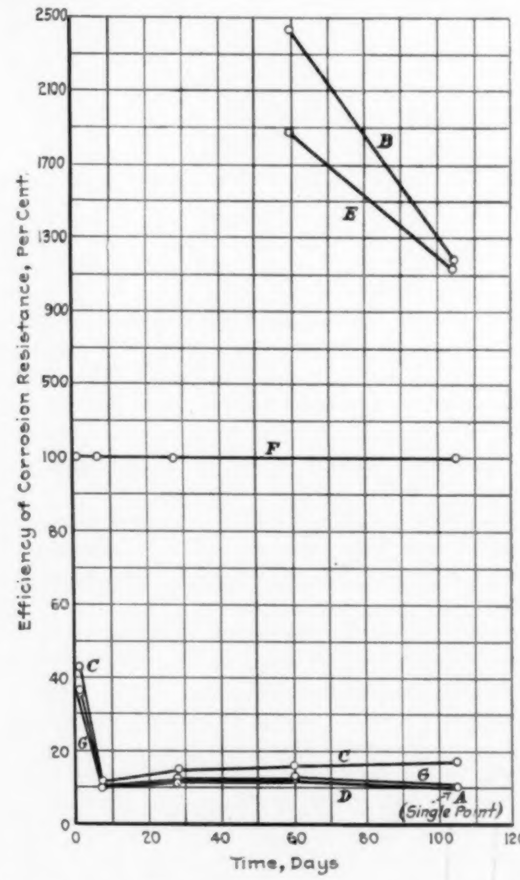


FIG. 4 RELATIVE EFFICIENCIES OF CORROSION RESISTANCE IN TAP WATER

1 The most impressive feature as seen in the curves of Figs. 1, 2 and 3 is the consistent grouping of the more corrosive iron and steel alloys A, C, D, and G, as against the highly resistant alloys B, E and F, in which copper and nickel are the most prominent constitutents. In the first group it should be noted that the steel C, in which titanium is employed as a cleanser, shows considerably less corrosion than the other steels in tap water and weak salt colutions. In the second group the copper-nickel alloy B was in most cases superior and in no case inferior to all the other alloys. This was the only alloy that exhibited its original appearance after being cleaned in the ammonium citrate solution.

2 Perhaps the next most impressive fact brought out by these tests is the decreased corrosion of the more corrosive group of alloys as sea salt is added to tap water. This effect is not observed in the non-corrosive group of alloys, for the reason that it is probably masked by experimental errors in determining the very slight losses in weight. This decreased corrosion with increased concentration of the salt solution is

in harmony with the results of other experimenters, notably Friend and Barnet.[1]

3 The practically pure iron *A*, which was received in time for only the 105-day test, gave very disappointing results, since in all three corroding media it showed practically the same corrosion as the ordinary carbon steels, *D* and *G*. However, in fairness it should be pointed out that rust may either accelerate or inhibit corrosion. If the metal is homogeneous, sound, dense, and free from occluded gases, the rust will probably be dense and closely adherent and will thus offer some degree of protection. If the metal is non-homogeneous and contains a considerable amount of occluded gases, the latter upon escaping will cause the rust to become spongy and porous, and will therefore permit the electrolyte to come more readily into contact with the metal. In the case of the practically pure iron *A* only one test (105 days long) was run, and consequently no curve of results could be obtained.

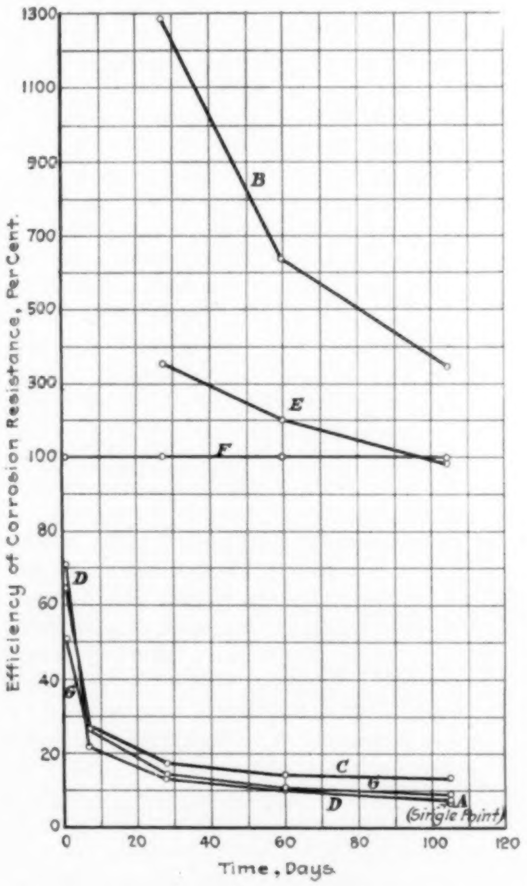


FIG. 5 RELATIVE EFFICIENCIES OF CORROSION RESISTANCE IN 0.10 PER CENT SEA-SALT SOLUTION

4 A study of the data points to the conclusion that when corrosion specimens are fairly uniform in density, area of exposed surface and volume, the method of expressing the relative corrosions by per cent loss in weight gives results as consistent as those obtained by the newly proposed method, for the average deviations of both methods are practically equal. It should be kept in mind, however, that the use of the new method, in cases where the specimens vary considerably among themselves with regard to density or ratio of surface to volume, will serve to give a much better basis for comparison than any other method.

5 The relative efficiencies of corrosion resistance as shown graphically by Figs. 4, 5 and 6 indicate that very consistent results can be obtained by the method of testing employed in these series, when the duration of the test is one week or more for the more corrosive alloys and about two months or more for the less corrosive alloys. In fact, one day is quite sufficient to classify groups of alloys in the order of their corrodibility for such corroding media as will cause enough loss in weight to be determined by analytical balances. Nevertheless, before any final conclusion can be drawn as to the best method of testing relative corrosion, a vast amount of work will have to be done, especially with reference to the results of service tests as compared with laboratory tests similar to those described in this article. For the present, however, it seems proper to conclude that very consistent results (at least among themselves) can be obtained by using small specimens and employing refined methods, but without using "accelerating" conditions.

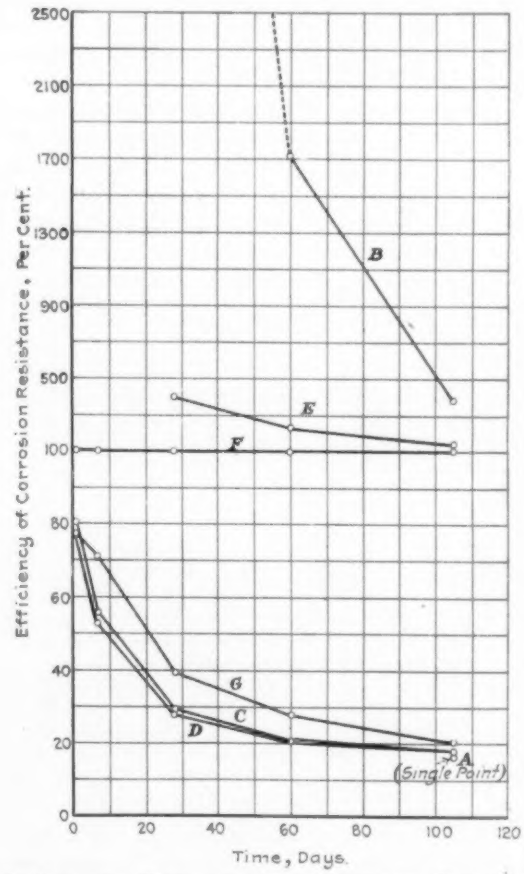


FIG. 6 RELATIVE EFFICIENCIES OF CORROSION RESISTANCE IN 10 PER CENT SEA-SALT SOLUTION

ACKNOWLEDGMENT

The writer wishes to record his appreciation of the assistance and coöperation of Dr. J. P. Jackson, formerly Dean, and of Prof. R. L. Sackett, the present Dean of the School of Engineering; to Prof. J. A. Moyer, and to Prof. M. M. Garver. He also desires to acknowledge the services rendered by M. P. Helman and G. S. Long, who prepared the specimens and obtained much of the data; and by E. F. Grundhoeffer, who, with the assistance of A. A. Bawiec and L. S. Longenecker, made most of the calculations and drew the curves.

[1] The Corrosion of Iron in Aqueous Solutions of Inorganic Salts, by J. Newton Friend and Peter C. Barnet, *Journal of the Iron and Steel Institute*, 1915, I, p. 336.

RECOVERY OF GASOLINE FROM CASING-HEAD AND NATURAL GAS

By PAUL DISERENS,[1] CINCINNATI, OHIO

CASING-HEAD gasoline is gasoline which passes off in the form of vapor with natural gas accompanying the flow of an oil well, where oil and gas are found in the same field. In many localities this gas is wasted because of the difficulty of handling it, or because no market exists for its sale, due to its relatively small volume. Often, however, the recoverable gasoline in the gas is worth as much as 20 per cent of the oil produced.

The practice of pumping casing-head gas to develop a vacuum on the well and thus to stimulate the flow of oil is, at this time, rapidly increasing and it is where this is done that plants for the recovery of casing-head gasoline are most profitable. In some fields, particularly California and Wyoming, gas is handled which comes directly from the wells under rock pressure or where the gas comes directly from gas wells. Such gas, however, yields relatively small quantities of gasoline.

TABLE 1 VAPOR PRESSURES AND CORRESPONDING TEMPERATURES AT WHICH CERTAIN HYDROCARBONS WILL CONDENSE

Temperature, Deg. Fahr.	Vapor Pressure, Lb. per Sq. In.				
	Propane C_3H_8	Butane C_4H_{10}	Pentane C_5H_{12}	Hexane C_6H_{14}	Heptane C_7H_{16}
32	72.5	15.9	3.5	0.9	0.2
40	84.6	19.9	4.4	1.0	0.3
50	100.7	24.1	5.4	1.4	0.4
60	115.4	30.0	6.8	2.0	0.5
70	130.1	36.7	8.2	2.5	0.7
80	147.2	44.1	9.9	2.9	0.9
90	165.0	53.2	11.9	3.2	1.1

The process most used in the recovery of casing-head gasoline is a physical one and involves only the alternate compression and cooling of the gas. As already stated, it will be understood that gasoline in the form of vapor constitutes part of the gas as it comes from the well or casing head. If the gas were saturated, gasoline would be immediately precipitated when compressed, provided it could be kept at a constant temperature, but since the heat of compression increases its temperature, the gasoline is still retained as vapor. When it is cooled, however, gasoline is thrown down in the form of condensate, and if the gas is cooled to its original temperature the gasoline still retained in it as vapor will only be in the proportion of its initial and final volume, or very approximately so. Since there are always present a great number of condensable fractions, each a different hydrocarbon of the paraffin series, the precipitate of each depends upon the partial pressure of each.

The vapor pressures at which some of the hydrocarbons of the parafin series constituting casing-head gas will condense for various temperatures are shown in Table 1. It is never practical to determine exactly which of these hydrocarbons occur in the particular casing-head gas to be handled, or in what proportions they are found. It is not possible, therefore, to predict what total pressure it will be best to carry. Generally, however, it is found advisable to carry not less than 250 lb. and it seldom is profitable to carry more than 300 lb.

The application of the principle as briefly stated requires the installation of a two-stage gas compressor with suitable intercooler and aftercooler. Vacuum pumps for bringing the gas from the wells to the plant are also required. The intercooler and aftercooler are of the open-coil type, and assuming that the surface available is large, the efficiency attainable depends upon the temperature of the cooling water. It is of great importance, therefore, to make provision for an ample supply of water. For this purpose cooling towers are generally provided, since in most oil fields fresh water is obtainable only in limited quantities. With cooling towers, even of the best design, it is impossible to attain low temperature during the hot weather, which prevails during a large part of the year. As a means, therefore, of supplying additional cooling effect, an expander refrigerator is installed, the function of which is to reduce further the temperature of the gas itself after having passed through the cooling coils. It consists of a cross-compound expansion engine driving a gas compressor. The compressed gas coming from the aftercooler is used in this expansion engine, and because of the work done in its cylinders is expanded adiabatically, or, in other words, in such a manner as to reduce its temperature. The cold gas is then returned through double pipe coils where its refrigerating effect is utilized to further cool the compressed gas. The amount of refrigeration thus available is in direct proportion to the amount of work done in the compression cylinders driven by the expander, and is proportioned to the total number of expansions; that is, to the ratio between its initial and final pressure, provided, of course, the cylinders of the expander are properly proportioned. The expander produces this refrigeration without the expenditure of additional power, and the energy in the compressed gas, which otherwise would of necessity be wasted, is available for useful work in compressing additional gas used in the process.

Fig. 1 shows a plan and elevation of a gasoline plant. The gas is delivered by means of vacuum pumps, reference to which will be made later, to the tank A, where such gasoline as will be precipitated under ordinary conditions of temperature and atmospheric pressure or even slight vacuum is collected. The suction line to the low-pressure compressor is taken from the top of the so-called drip tank and leads to the low-pressure compressor F, where it is compressed to approximately 40 lb. gage pressure. It is then delivered to the cooling coils C. The condensation collected in these coils is drawn off through a trap and the dry gas returned to the suction of the high-pressure compressor E, where it is compressed to about 250 lb. and again passed through cooling coils G. The condensed gasoline in these coils is also removed by means of a trap and delivered to suitable storage tanks.

The original design of the plant as shown provided for the expansion of the compressed gas through a so-called Tripler tube D. This tube is similar in design to the ordinary double-pipe ammonia coil, the expanded gas passing around

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and surrounding the internal tube through which the compressed gas from the high stage is passed. The expansion of the high-pressure gas in this tube brings about a temperature reduction of the high-pressure gas and additional gasoline is precipitated. The impossibility of expanding gas adiabatically through a nozzle is well understood and for this reason it never has been possible to effect any great temperature reduction in this Tripler tube. As long as the expanded gas retains its high velocity the temperature is relatively low, but as soon as it comes to rest it rises very rapidly.

When the high-pressure gas expanded through the reducing valve in the Tripler tube contains appreciable quantities of gasoline in the form of mist rather than as a vapor, a considerable amount of cooling will be realized when this gasoline flashes into vapor as soon as the reduction in pressure lb. pressure and is exhausted against a back pressure of 15 to 20 lb. through the collecting tank *B*, and thence through the outside of the double pipe coil *D*, where it serves to cool the compressed gas within the inner tubes. The power developed in the expansion engine is used to compress additional gas, and this gas is delivered to the same intercooler and aftercooler, *C* and *G*, used by the main compressors.

The general piping arrangement in the plan as shown is rather crude, but is fairly representative of most plants which have been in operation for two or three years. In some of the more modern plants a much more convenient and flexible arrangement will be found.

Even with a single-stage expander as installed in this plant, a very great increase in the yield of gasoline has resulted.

The successful operation of this small single-stage expander

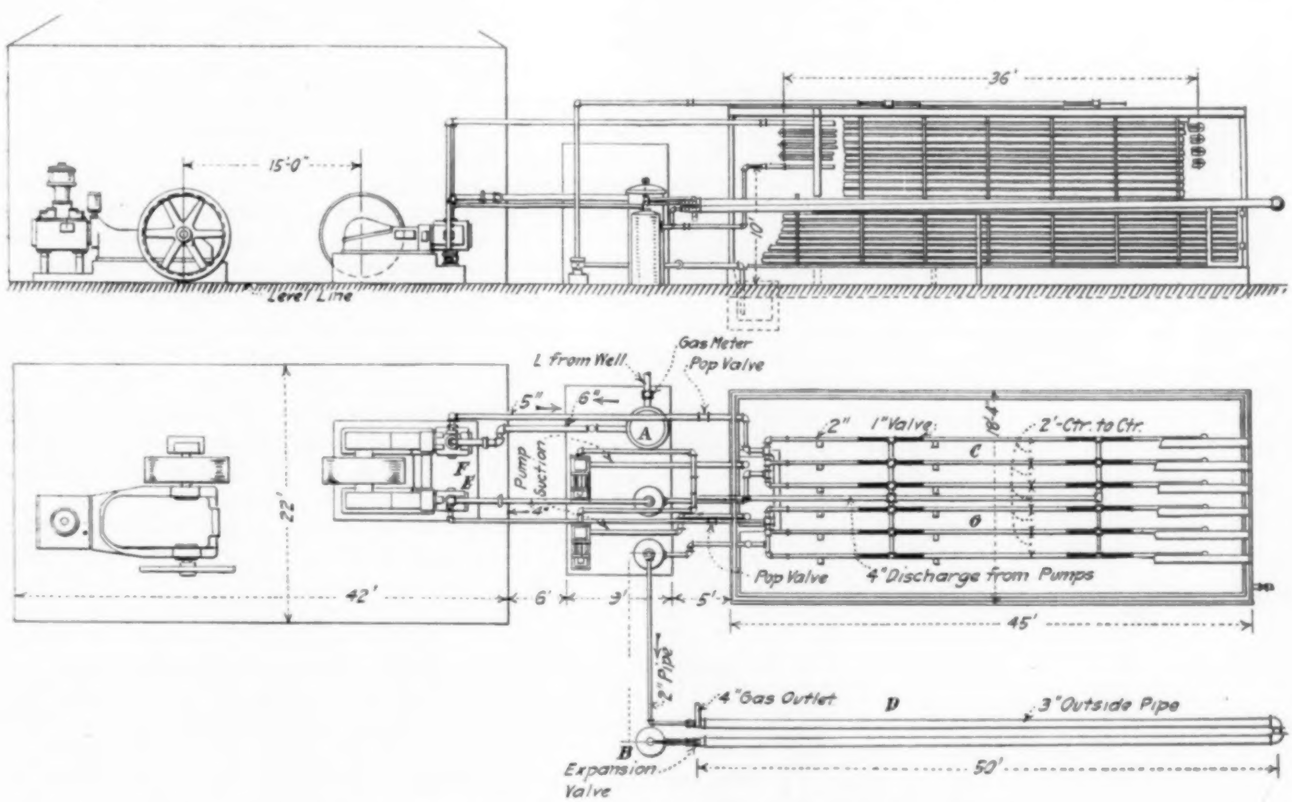

Fig. 1 Plan and Elevation of Feather Valve Compressor

takes place. This is explained, of course, by the fact that the heat of vaporization must come from the gas which carries the gasoline. A well-designed plant, however, should be equipped with accumulator tanks of sufficient size to separate practically all entrained liquid, and if this is done, the high-pressure gas will be practically dry when it reaches the expansion valve. Thus, if considerable refrigeration is actually brought about in the Tripler tube, it only signifies that the design of the plant is faulty. By the use of a Tripler tube some of this loss may be recovered in shape of refrigeration. The net result, however, will be a definite loss.

In order to bring about a greater temperature reduction through the expansion of this high-pressure gas, an expander compressor was installed. In the plant shown, a small single-stage expander was installed after the plant as just described was put in operation. The high-pressure gas after passing through the double pipe coil is admitted to the expansion cylinder of the expander compressor at approximately 250 was not easily accomplished. The collection of ice around the valves, together with the difficulty of lubricating them, made necessary numerous shutdowns. It was soon found, however, that by using glycerine in very small quantities as a lubricant and by applying this directly to the rubbing surfaces, the machine could be operated almost continuously. Whenever it was possible to reduce the temperature of the compressed gas approximately to the freezing point, all water vapor contained in it was frozen and thus removed before entering the expander. In very warm weather the amount of refrigeration available was not sufficient to bring about so great a temperature reduction, and at these times, after continued operation, the ice collecting in the exhaust ports and in the valve chest seriously interfered with its operation. It was found necessary to thaw out the expander at regular intervals, generally once in 24 hours. For this purpose a bypass pipe leading directly from the high pressure compressor was used to bring high-pressure gas, before being

cooled by the water coils, directly to the expansion cylinders. The temperature of this gas was sufficient to thaw out the ports in a very short time.

In order to overcome to a certain extent many of these difficulties in operation and in order to secure considerably lower temperatures, the expander compressor is now made as

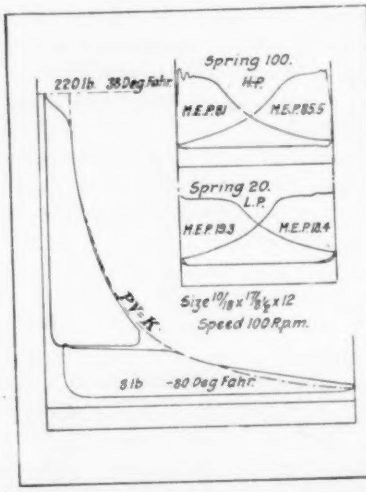

FIG. 2 TYPICAL INDICATOR CARDS FROM EXPANSION CYLINDERS OF GAS EXPANDER

a cross-compound machine. It is possible, therefore, to carry the expansion much further and to reduce the temperature of the gas to a far greater extent.

No insulating material was used in this installation, and therefore the very low temperatures obtained were shown in a very spectacular manner. Frost and ice cover the cylinders and exhaust pipes to a depth of 6 to 10 in. The machine has expansion cylinders 10 in. and 18 in. in diameter with compression cylinders 17 in. and 8½ in. in diameter, respectively; the stroke is 12 in. Indicator cards taken from the expansion cylinders (Fig. 2) show the performance of this machine. These cards are of particular interest. It will be seen that the expansion line follows very closely an equilateral hyperbola and therefore is not nearly so steep as the adiabatic, as might be expected. The explanation, however, is quite evident, since the gas handled is not a dry gas but is in fact a mixture of dry gas and numerous condensable vapors of the various hydrocarbons referred to above. As soon as this mixture enters the cylinder and comes in contact with the very cold walls and ports, initial condensation takes place and as expansion proceeds, reëxpansion occurs exactly as in the case of the steam engine. The initial condensation, however, is very much greater and it is necessary to provide suitable drains in both cylinders to take care of the gasoline thus precipitated.

The initial temperature of the gas entering the high-pressure expansion cylinder in the plant in which these cards were taken, averaged about 38 deg. fahr., while the temperature at the exhaust of the low-pressure expansion cylinder was 80 deg. below zero. The temperature of the high-pressure gas before entering the double pipe coils, through which the exhaust gas from the expander is taken, was 90 deg. If there had been no condensation in the expander cylinders and if the interchange of heat within the double pipe coils had been accomplished without loss by radiation, the final temperature of 80 deg. below zero should have been sufficient to reduce the temperature of the incoming gas to zero instead of 38 deg. above zero, since the compressed and expanded gas are of the same weight.

In order to bring about more complete interchange of heat and in order to limit initial condensation, in one of the most recent installations the two-stage expander was arranged so as to exhaust first from the high-pressure expander cylinder through a set of double pipe coils and then after further expansion in the low-pressure cylinder through another set of double pipe coils. By this means the range of temperature is, of course, greatly reduced and because of this fact there is considerably less initial condensation and, therefore, a greater interchange of heat. The general arrangement for such an installation is shown in Fig. 3.

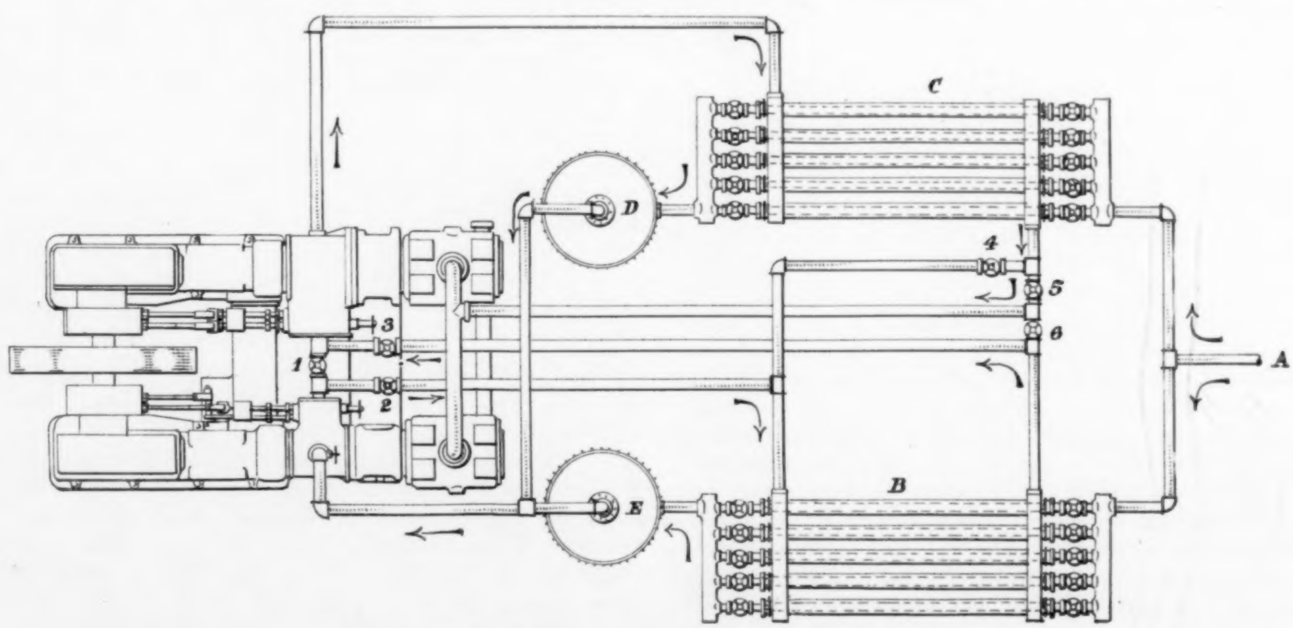

FIG. 3 HEAT EXCHANGER FOR TWO-STAGE EXPANDER

The practical operation of these two-stage expanders is

considerably simpler than that of the single-stage expanders originally installed. The reason is, of course, because of the considerably greater refrigerating effect obtained. In many plants it is easily possible to operate the expander continuously for indefinite periods, but in particularly warm climates and where the gas is very rich in condensable vapors, the temperatures even with a two-stage machine are not sufficiently low to prevent accumulation of ice within the cylinders. By using hot gas at regular intervals to thaw out the pipes, these plants can be operated very successfully.

Next to the expander the vacuum pump is, perhaps, the most interesting apparatus used in a gasoline plant. When the production of relatively old wells begins to fall off, it has been found that the flow of oil can be very materially increased by developing a vacuum in the casing. Until recently this was done by attaching a rather crude direct-acting pump directly to the rigging of the well. With a pump of this kind it is seldom possible to develop a vacuum of more than 10 in. to 12 in. of mercury. Competition between owners of adjoining leases to carry the highest possible vacuum, in order to get their full share of the oil, has recently brought about a demand for vacuum pumps of much greater efficiency, and so within the last few years a great number of high-speed, high-efficiency vacuum pumps driven by gas engines have been installed.

While there are now on the market two or three vacuum pumps of relatively high efficiency, the newest and perhaps the most novel in design is found in the Laidlaw feather-valve vacuum pump. Its construction and performance will therefore be of interest.

This vacuum pump depends for high efficiency upon close clearance and its distinguishing feature is found in the use of voluntary valves of the feather type. Each valve consists of a number of thin, flexible strips of spring steel, working on a flat seat and opening against a slotted guard. The ends of the valves never leave the valve seat, the opening being accomplished by continuous bending of the valve strip itself. The valve, therefore, in closing, seats through gradual contact from the ends of the valve toward the center and not by direct impact. This makes it possible to give the valve a relatively high lift and consequently relatively large valve area. Because of the extreme flexibility of the valve strips used, even the very light pressures incident to vacuum-pump work are sufficient to hold the valve to the seat with extreme tightness.

A vacuum pump of this type can easily develop a vacuum on closed suction of 29½ in. of mercury, or in other words, within ½ in. of the barometer. This, of course, determines the volumetric efficiency of the vacuum pump at any working vacuum, for assuming that the volumetric loss in a vacuum pump is directly proportional to the number of compressions under any working conditions, the volumetric loss will be the ratio of this number of compressions to that obtained with the pump working on a closed suction, since under this condition of operation the volumetric efficiency will be zero, in other words, when the volumetric loss exactly equals the capacity of the pump. With this assumption it is possible to express algebraically the actual capacity of any vacuum pump for any given working condition. For example, the actual capacity of a vacuum pump having a displacement of D cu. ft. per min. that will deliver Q cu. ft. of free gas per 24 hours, is expressed in the following formula: $Q = 1440\ D \times (C - V)/B$, where B is the barometric pressure, V the actual working vacuum and C the vacuum developed on closed suction. The relationship thus defined gives a very simple means of determining the size of pump required for any particular service, for it is only necessary to know the amount of gas available, the vacuum at which it is to be handled and the vacuum which the pump will develop with its suction closed.

In order to facilitate the choice of a pump for any particular service, the chart shown in Fig. 4 will be useful. This chart shows the capacity of vacuum pumps having any displacement ranging from 500 cu. ft. per min. to 10,000 cu. ft. per min. and working under any degree of vacuum up to 28½ in. of mercury, referred to a barometer reading of 29½ in. On this chart are shown three efficiency lines, corresponding to pumps capable of maintaining ½, 1 and 1½ in. of mercury absolute on a closed suction.

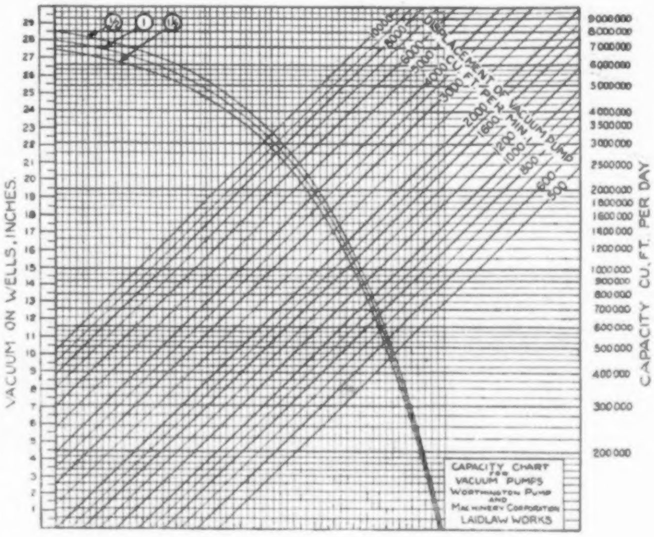

Fig. 4 Capacity Chart for Vacuum Pumps

The use of this chart is illustrated by the following example: If it is required to select a pump capable of handling 500,000 cu. ft. of free gas per day at 21 in. of vacuum, proceed as follows: Select the horizontal line marked "21 inches" at the left of the diagram; follow this line in a horizontal direction to its intersection with the curved efficiency line marked "one-half inch." On the vertical line passing through this intersection, proceed vertically until the horizontal line marked 500,000 on the extreme right of the diagram is reached. The diagonal line passing through this intersection represents the displacement in cubic feet per minute of the vacuum pump, which will give the required service. It will be seen in the example selected that the vacuum pump must have a displacement of 1200 cu. ft. per min.

The results of a test on one of these vacuum pumps to determine its actual volumetric efficiency are shown in this diagram. The quantity of air handled was measured by means of a low-pressure orifice, using Professor Durley's coefficients; the results are plotted as volumetric efficiency for various working vacua. The heavy line shown in this diagram represents the volumetric efficiency calculated from the chart already shown. The actual test results coincide with a fair degree of accuracy with those estimated from the chart.

Another method of recovering gasoline from natural gas or casing-head gas is by what is known as the absorption process. This process is used primarily where the gas treated is lean, that is, when its gasoline content is small.

In the absorption process the wet gas, together with the absorbing oil (usually mineral-seal or straw oil), is forced

under pressure into the absorber where the two come into intimate contact, the proportions of gas and oil being so controlled that the oil, when leaving the absorber, will be approximately saturated with condensable vapor from the gas. On leaving the absorber the saturated oil is passed through suitable heat interchangers, where its temperature is raised by means of hot return oil from the still. The hot saturated oil is then led to the still, where additional heat is applied, and the gasoline

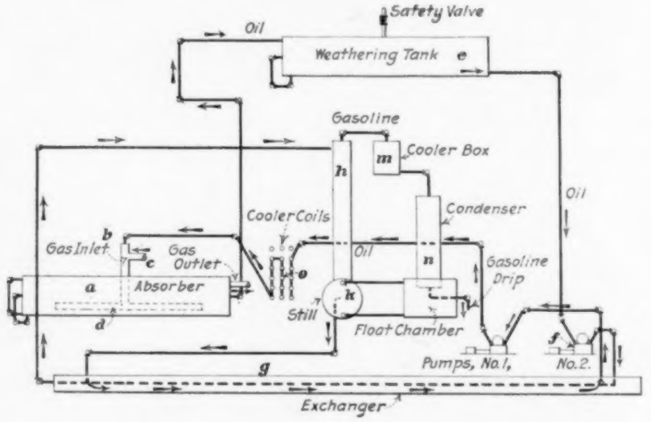

FIG. 5 GENERAL ARRANGEMENT OF SMALL GASOLINE ABSORPTION PLANT (BULLETIN 120, BUREAU OF MINES)

driven off in the form of vapor. These gasoline vapors are condensed in water-cooled coils and delivered to suitable blending and storage tanks. The residue-absorbing oil is then returned to the heat interchanger, where it gives up a great part of its heat to fresh saturated oil, as described above, after which it is passed through a cooler similar in design to the water-cooler coils of the compression plant, where its temperature is reduced to the lowest possible point. After cooling the oil is returned directly to the absorber. It will be seen that the process is a continuous one, and that the absorbing oil is used over and over again.

Fig. 5 shows diagramatically the general arrangement of a small absorption plant. The natural gas, which is brought in from a pipe line under pressure, enters the absorbing tank

tower *h* of the steam still *k*, where the gasoline is distilled from the oil with live steam. The cooler *m* separates the water (condensed steam) from the gasoline, which is condensed in the condenser and flows out of the system at the gasoline drip.

The hot oil after having been freed of its gasoline is pressed through the heat exchanger *g* and heats the oil passing to the still and from No. 1 pump it is forced through the cooling coils *o*, on which running water drops. The cooled oil then passes into the absorber *a* to receive another charge of gasoline.

In the absorption method it will be seen that a very considerable amount of gas must be burned under boilers to generate sufficient steam to operate the steam stills. Since in nearly every instance absorption plants are installed as an adjunct to a gas-pumping station used to supply gas for domestic service, the diversion of any considerable amount of gas to operate boilers instead of pumping it through the mains where it has a market value of probably 30 or 40 cents per 1000 cu. ft., operates to greatly reduce the profits to be derived from the gasoline plant. Any system, therefore, which will do away with the necessity of separating the gasoline from the absorbing oil by means of steam stills is greatly to be desired. While as yet no such plants have been installed, a very interesting solution of the problem has been proposed in a combination of the absorption and compression processes. The plan contemplates the absorption of the gasoline in the usual way, as already described, and then introducing the resulting blend of absorbing oil and gasoline into a closed vessel in which a high vacuum is maintained. The gasoline will, of course, immediately volatilize, and may be removed by means of vacuum pumps, passed through cooling coils and condensed.

The general arrangement of such a plant is shown in Fig. 6. It will be seen that it consists of three elements, an evaporator, a vacuum pump, and a bank of cooling coils with suitable accumulator tank. The saturated oil from the absorbers is pumped into the evaporator through spray nozzles which deliver it in a finely divided mist. Because of its relatively low boiling point the gasoline must of course come from the absorbing liquid, and thus the process brings about a refrigerating effect and the oil itself is cooled. This is an item of extreme importance, since the oil upon its return to the ab-

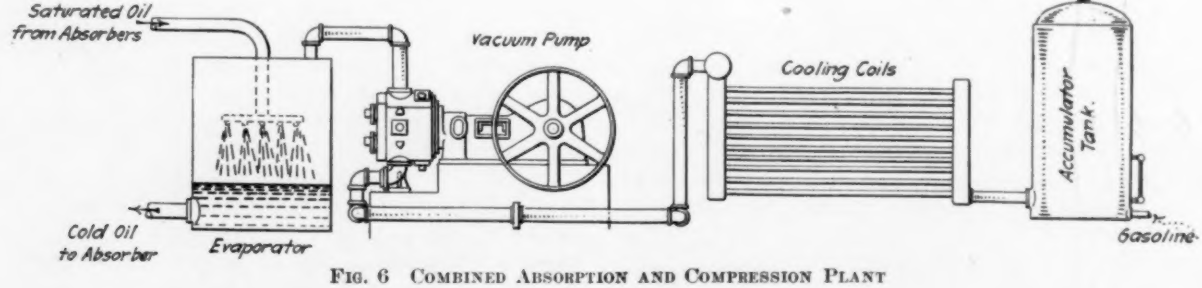

FIG. 6 COMBINED ABSORPTION AND COMPRESSION PLANT

at *c* and the oil enters at *b*. They pass into the T-pipe *d*, and the mixture passes from there through many small holes into the oil contained in the absorber. The gas bubbles up through the oil and passes out of the absorber as shown and returns to the pipe line.

The oil charged with gasoline passes first to the weathering tank *e*, where the lighter parts of the gasoline are released through the safety valve. Next the oil enters the pump *f* and is pumped through the heat exchanger *g* into the rock

sorbers will be at a temperature low enough to bring about most effective absorption. In the ordinary absorption plant the principal factor which limits its efficiency is this temperature, and great pains are always taken to keep it as low as possible. The vacuum pump serves not only to maintain the required vacuum within the evaporator, but also to remove the gasoline vapors. These are delivered to the cooling coils, which may be in every way similar to those used in the compression process.

THE INCOME TAX—AN ENGINEER'S ANALYSIS

By CARL G. BARTH,[1] PHILADELPHIA, PA.

IN view of the revenue bill now pending before Congress, involving a revision of the present income-tax law, a paper presented by Carl G. Barth at the February 26, 1918, meeting of the Philadelphia Section of The American Society of Mechanical Engineers is of timely interest.

In a telegram from Washington, published by the Chicago *Herald* in August 1917, which gave the status at that time, in the Senate Finance Committee, of the personal income-tax law, Mr. Barth observed that reference was made only to the incomes to be taxed at various rates, and being impressed with the lack of regularity in the increases at which incomes were taxed with increasing tax rates, as well as in the tax rates themselves, he decided, inasmuch as the term "graded or graduated tax" seemed to imply a tax or tax rate that would gradually increase with increase of income, to investigate the matter mathematically in the same way he was accustomed to deal with practical engineering problems, leaving to others the consideration of its broader financial and economic aspects. It appeared to him that the framers of the law, having had in mind to devise a scale of tax rates increasing in proportion to the incomes to which they were applied—a problem altogether mathematical, since it involved the determination of a series of numbers—had nevertheless selected a scheme of graded taxation with arbitrary steps of percentages.

Two of the results of Mr. Barth's investigations are presented below—his analysis of the present law by comparison with an approximate mathematical expression which may be said to represent the intention of the law, and the general formula he recommends as suitable and convenient for the determination of a graded tax.

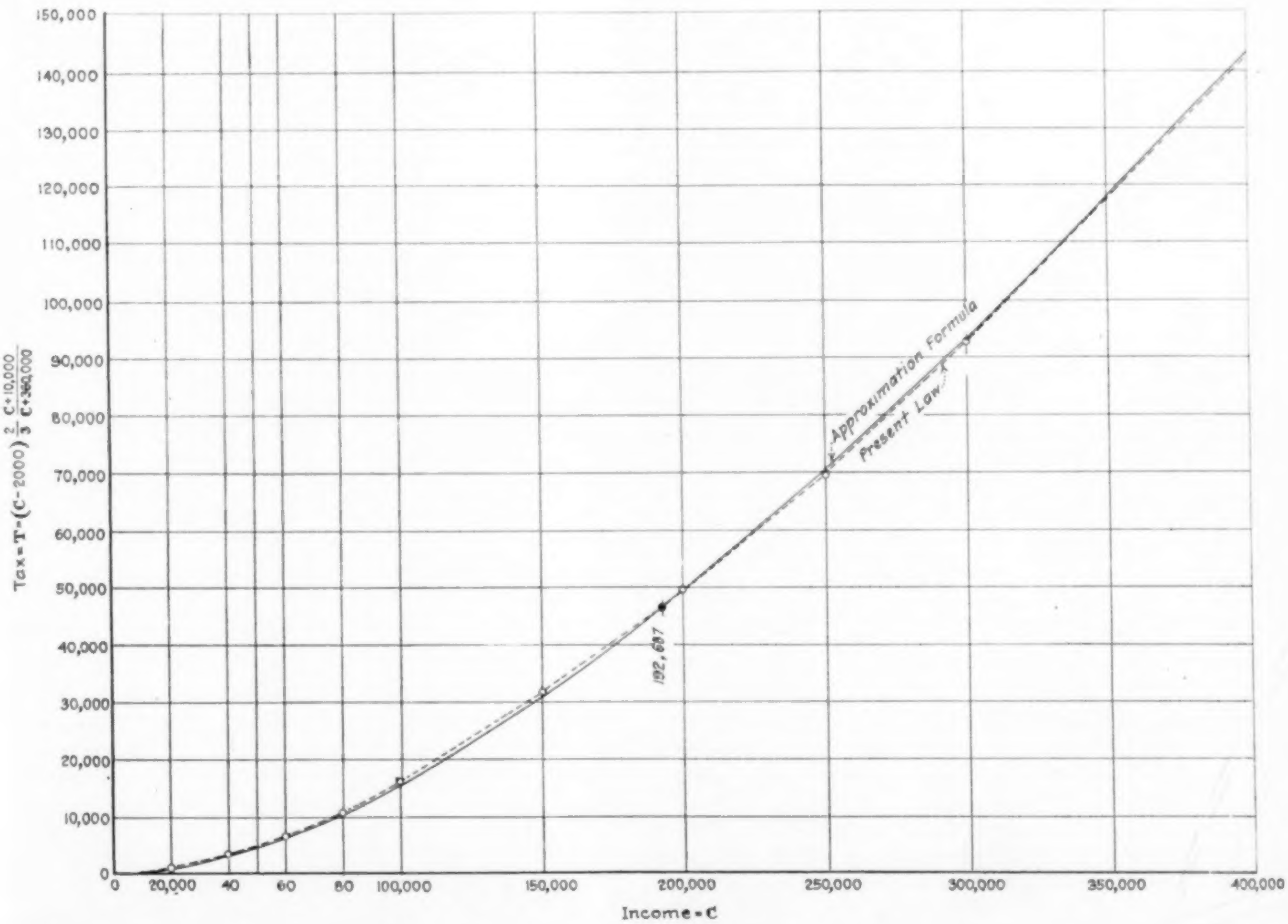

FIG. 1 COMPARISON OF THE INCOME TAX LAW AS REPRESENTED BY THE DOTTED LINE, WITH ITS APPROXIMATION FORMULA [1] AS REPRESENTED BY THE FULL-LINE CURVE

The empirical formula

$$T = (C - 2000) \cdot \tfrac{2}{3} \cdot \frac{C + 10{,}000}{C + 360{,}000} \quad \text{[1]}$$

according to Mr. Barth, expresses very closely the relation between the net taxable income C and the tax T as determined for married men by the present law.

The equation of the full-line curve in Fig. 1 is Formula [1].

[1] Senior member, Carl G. Barth & Son. Mem.Am.Soc.M.E.

The paper is here presented in abstract. The complete paper has been reprinted in pamphlet form by The Engineers' Club of Philadelphia.

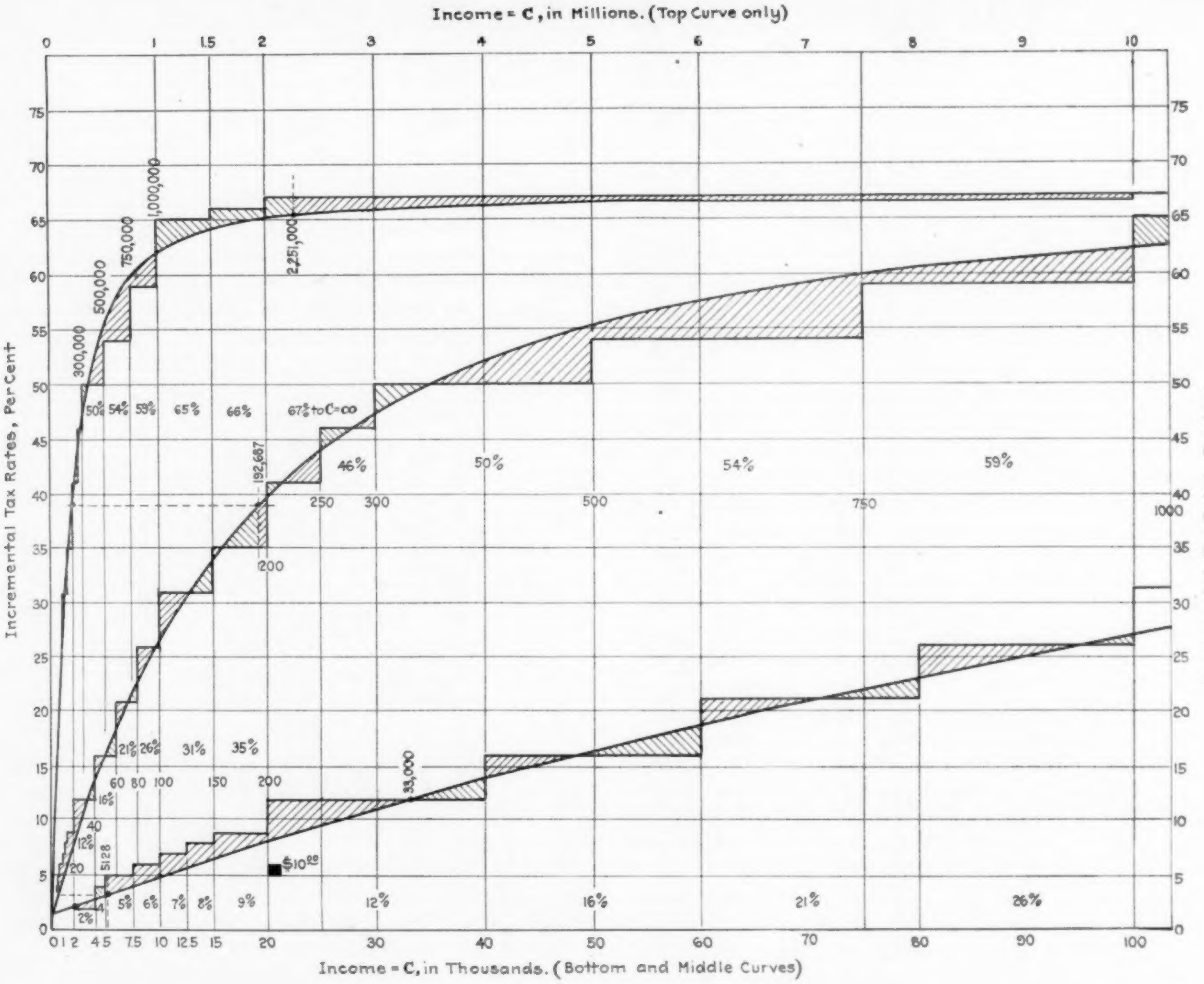

FIG. 2 GRAPHICAL REPRESENTATION OF THE DISCREPANCIES BETWEEN THE INCOME TAX LAW AND FORMULA [1]. THE SHADED AREAS ABOVE THE SMOOTH CURVE INDICATE FIELDS OF OVERTAXATION; THOSE BELOW, FIELDS OF UNDERTAXATION

The dotted line was obtained by drawing a smooth curve through the points marked with a circle, the coördinates of these points representing corresponding values of income and tax as determined by the present law.

A more conspicuous comparison of the law and the formula is shown in Fig. 2, where the bottom field covers incomes up to $100,000, on a comparatively large scale; the middle field, incomes up to $1,000,000, on a scale equal to one-tenth of the former; and, finally, the top field, incomes up to $10,000,000, on a scale equal to one one-hundredth of that of the bottom field; while in all three fields the scale is the same for the percentage of tax levied in the various fields of incomes.

In the main bottom field of Fig. 2 at the income $2000 where taxation begins at 2 per cent, the $40 of tax between 0 and $4000 is represented by the little rectangle in which 2 per cent is written, such that half of this rectangle similarly represents the tax up to $3000. Similarly, the rectangle between the incomes $4000 and $5000, the upper part of which is shaded and in which four is written, represents tax on $1000 at 4 per cent, or an additional $40. Again, the rectangle between the incomes $5000 and $7500, the upper part of which is also shaded and in which 5 is written, represents a further additional tax on $2500 at 5 per cent, or $125, and so on through the whole diagram, such that the total area covered by all the rectangles from the income $2000 up to any other income, represents the total tax on such latter income. The curve, the area between which and the upper limit of each rectangle is shaded, represents the gradually increasing tax rate that corresponds to Formula [1].

That area between the base line of the diagram and this curve which lies between any two incomes, accordingly represents that tax between these incomes which is called for by the formula. The shaded areas that lie above the curve represent the overtaxation of the law in the various fields, while the shaded areas that lie below the curve similarly represent the undertaxation of the law, such that, when once understood, the diagram most clearly and conclusively demonstrates not only the lack of continuity, but also the lack of regularity in the attempted compromises in the present law. It also most clearly shows that there is a relative undertaxation from $2000 up to $4000, and relative overtaxation all the way from $4000 to $33,000, such that the undertaxation below $4000 is exactly balanced by the overtaxation between $4000 and $5128. Between $33,000 and $192,687 over- and undertaxation so alternate, with the excess undertaxation so great between $150,000 and $192,687 that at this latter income the net result is again

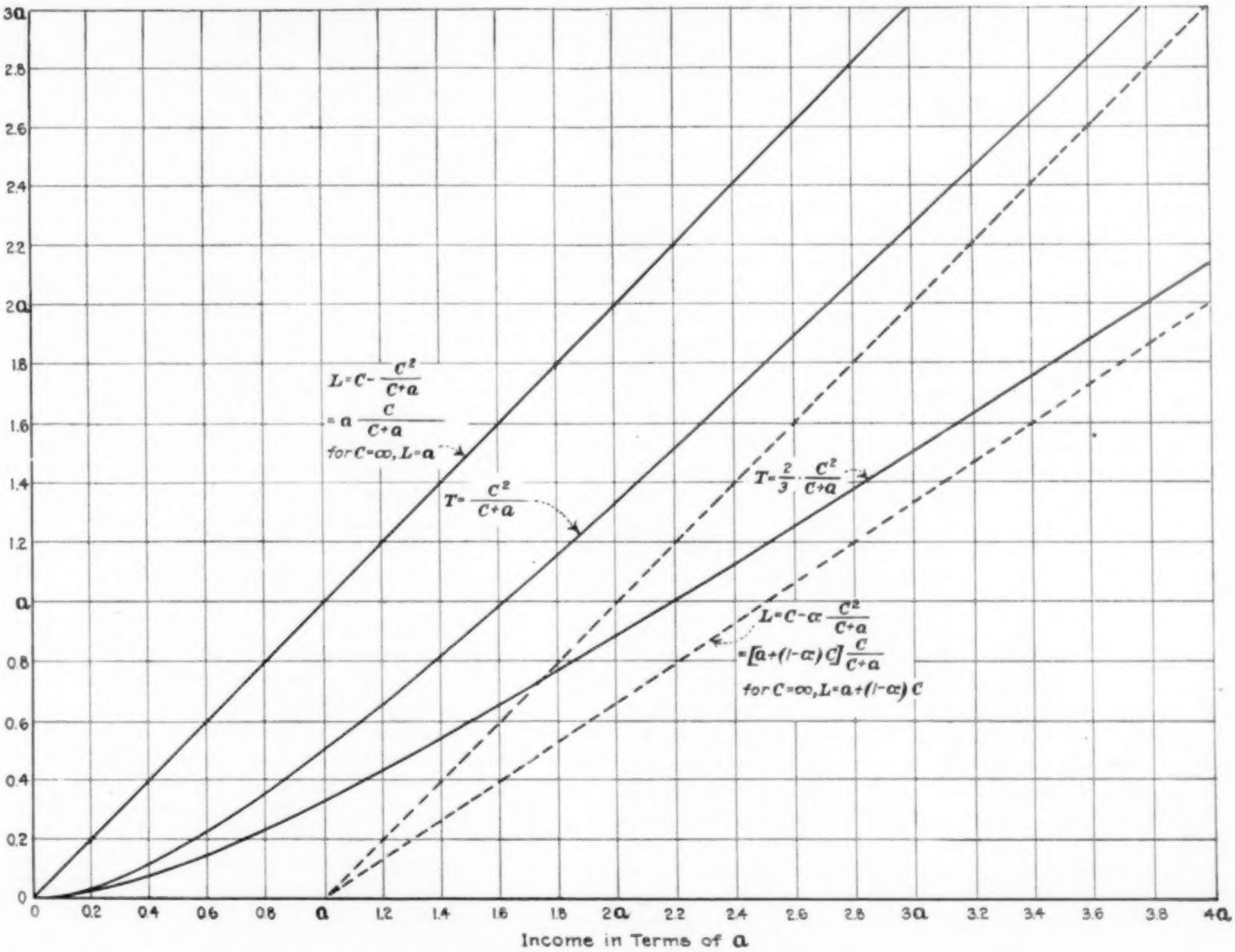

FIG. 3 GRAPHICAL REPRESENTATION OF FORMULÆ [2] AND [4]. UPPER FULL-LINE CURVE CORRESPONDS TO FORMULA [2] FOR a = 1: LOWER FULL-LINE CURVE, TO THE SAME FORMULA FOR a = 2/3

a coincidence with the formula. Between $192,687 and $350,000 the alternating undertaxation and overtaxation will be seen to balance each other pretty well; but from $350,000 up to $1,000,000 the whole field will be seen to be undertaxed to an extent that amounts to a veritable discrimination in favor of all incomes between these limits.

From his discussion of Fig. 2, Mr. Barth concludes that a scheme of graded taxation with definite steps of percentages is subject to unavoidable minor injustices, and that full relative justice can be meted out only by taxing according to a continuous formula. He proposes, therefore, for any scheme of graded taxation, the adoption of the general formula

$$T = \alpha \frac{C^2}{C+a} \quad \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

where T is the tax, C the income, and α and a are constants to be determined from the fundamental economic and social conditions of the country. His discussion of the possibilities of this general Formula [2], according to the values given to the coefficients α and a, follows:

If α is made 1, the formula becomes

$$T = \frac{C^2}{C+a} \quad \ldots\ldots\ldots\ldots\ldots\ldots [3]$$

and in this form it may be considered as representing an ultimate limit in a graduated-taxation scheme, and as such must be fully understood and consulted before a rational selection can be made of values for either α or a in Formula [2].

In Fig. 3, Formula [3] is represented by the upper curve against which any income and its corresponding tax are read in terms of a. The upper, full line, being at an angle of 45 deg., reads an income against the vertical scale as well as against the horizontal scale, so that the vertical distance between this line and the curve represents the difference between an income and its tax, or what is left the taxpayer; and this amount more and more approaches the value a, which is the constant vertical distance between the full 45-deg. line and the dotted 45-deg. line which parallels it. Designating what is left the taxpayer by L, this amount may be written

$$L = C - T = C - \frac{C^2}{C+a} = \frac{aC}{C+a} = a\frac{C}{C+a}$$

which, as C gradually becomes greater and greater, approaches the value a as a limit, as $\frac{C}{C+a}$ then approaches 1 as a limit; which is thus a proof of the statement just made above. It is because of this property of Formula [3] that it may be considered as expressing an ultimate limit in a graduated-tax scheme; for, actually applied in practice, it would mean the practical confiscation of all large incomes, except for an amount which can never reach the value a. For a practical

taxation formula it is therefore necessary to assign a value to α in the general Formula [2] which is less than unity. In this case

$$L = C - T = C - \alpha \frac{C^2}{C+a} = \frac{C^2(1-\alpha)+aC}{C+a} =$$

$$[a + C(1-\alpha)]\frac{C}{C+a} \qquad [4]$$

which, as C becomes greater and greater, approaches the value $L = a + C(1-\alpha)$ as a limit. That is to say, when α is assigned a value less than unity, a taxpayer of infinitely great income, and who as such would be left proportionately the smallest part of his income, would be left a certain definite fraction of his income in addition to the amount a. While under no circumstances should Formula [3] be used directly for tax purposes, it nevertheless suggests a rational relation of a single-man's tax to that of a married man.

Mr. Barth's recommendation is the adoption for a graded income, or other graded tax, of the general formula:

$$T = \alpha \frac{C^2}{C+a} \qquad [2]$$

to be applied directly to single men, and modified to

$$T = \alpha \frac{C^2}{C + a + b\left(1+\frac{N}{m}\right)} \qquad [5]$$

for married men, in which N = number of children, and m a number which will depend on what consideration the number of children are deemed worthy of as compared with a wife. In the present law, which allows an exemption of $200 for each child, five children have the same consideration as their mother. Values for a, b, and m might well be assigned to serve their purpose for any period, however long, during which the fundamental economic and social conditions of the country do not undergo any radical change, such that the value of α alone would be subject to change as often as the financial condition of the government might require more or less tax to be levied. However, in fixing relatively permanent values for a, b, and m, their significance when α is made 1 should have the most careful consideration.

As a matter of purely theoretical interest, Formula [5] may be written thus:

$$T = \alpha \frac{C^2}{C + a + b\left(n+\frac{N}{m}\right)}$$

in which n = number of wives, with only two alternative possible values in Christian countries; namely, 0 for single men and 1 for married men. With $n = 0$, N must also be 0, in which case the formula reverts to Formula [2].

Mr. Barth concludes his paper with a mathematical discussion of Formula [2] in combination with Pareto's law of incomes.

By a study through a term of years, of the income-tax returns of a number of European and other countries, the Italian economist Vilfredo Pareto discovered that the distribution of a nation's total income among its taxpayers is by no means a matter of chance only, but is subject to a very definite law which holds very closely except for the highest and the lowest individual incomes.

Mr. Barth reduces the mathematical expression for Pareto's law to

$$N = A/C^{1.5}$$

where A is a constant for any one country at any one time in its economic development, C any individual income, and N the number of individuals that enjoy incomes in excess of C.

From this and Formula [2] he finally derives the value for Y_t, the total tax of a nation when levied by Formula [2]:

$$Y_t = 3A(\alpha/\sqrt{a})\,[\tan^{-1}\sqrt{X/a} - \tan^{-1}\sqrt{M/a}]$$

in which M and X are the minimum and the maximum individual incomes, respectively.

FIRE PROTECTION IN MANUFACTURING PLANTS

By CHARLES E. RIGBY,[1] PROVIDENCE, R. I.

THE protection of factories against fire is nothing less than their conservation, which is vital to the maintenance of the national interests in the present emergency. Facilities for extinguishing fires, however, are only a part of the means needed to secure proper control of the fire hazard, and it is necessary to take also into consideration the construction, the character and arrangement of the processes, the protection, and last, the hazard from nearby property and safeguards against this.

CONSTRUCTION

In designing a building the purpose for which it is to be used must be kept in mind. What might be considered good construction for one occupancy, such as a heavy machine-shop building—one story high with gallery and with roof of plank on exposed steel—would be poor for another occupancy, such as a cotton mill. The ideal factory is one having a single story, because in structures several stories high each floor is exposed by the others. It is interesting to note that while around the Civil War period it was the practice to build factories about six stories high, with a tendency later toward one-story structures, today, on the whole, we seem to have struck an average between the two.

Mill Construction. The construction that first commands our attention is the slow-burning or mill-construction type, in which the walls are usually of brick and the floors and roof of heavy plank supported by wooden beams strong enough to permit their being spaced 8 to 10 ft. apart. On the plank floors there is a thickness of boards to serve as a wearing surface, and often an intermediate layer put down diagonally for the sake of stiffness. Columns preferably are of wood, although cast iron gives acceptable results. This method of factory construction results in assembling the wooden parts in large units, the strength of which is not easily destroyed by fire. To prevent a fire from traveling from one floor to another, care must be taken that all openings through the floors are protected. This is best accomplished by locating stairs, elevators and belts in brick towers with any openings protected by automatic fire doors. This is not always possible, particularly in buildings already erected, but for these cases the protection outlined should be approximated by enclosing stairways with partitions of two thicknesses of boards laid to break joints, by providing automatic self-closing hatches at

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Abstract of paper presented at a meeting of the Connecticut Section, Meriden Branch, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, February 14, 1918.

the elevators, and by protecting the beltways with metal lath and plaster partitions or with substantial metal boxing easily removable for repairs.

Steel Construction. In steel construction the designer must keep in mind the likelihood of its quick failure, in the event of a fire, from bending or buckling. Fireproofing of steel in construction work is especially needed for columns in buildings several stories high, where the failure of a column in a lower story would bring down all above. Where there is to be a considerable amount of combustible stock it is also necessary to fireproof the beams, but for favorable occupancies, such as metal working, this is not always necessary except for important girders. For one-story buildings used for foundry and work of like nature, the use of exposed steel both for columns and girders is allowable.

Concrete Construction. The use of reinforced concrete makes possible a very safe factory, as each floor can be made a horizontal fire wall. It is unquestionably the type of construction best suited for use in congested sections. The cost, and sometimes the nature of business carried on, does not always warrant its adoption, although where loads are heavy and wide spans are desired, it is frequently not more expensive than other types of construction. Reinforced-concrete structures stood a severe test at the Edison Phonograph Works fire of 1914. These contained much inflammable material, which furnished fuel for an intense fire. The buildings were badly damaged by spalling and splitting of the columns, collapse of a small portion, and expansion causing pilasters at the ends to shear off. The point of interest is that the buildings were repaired at 20 per cent of the original cost.

Poor Construction. Of the several types of construction that should be avoided, the first to be considered here is the so-called joisted type, which gives for floors and roofs one or two thicknesses of boards supported by joists 2 in. thick and a foot or two on centers. In many cases sheathing or plaster is attached to the under side of the joists, but in so doing concealed spaces are formed in which a fire is hard to fight. The open type cannot readily be protected by hose streams or sprinklers, as can the mill-construction floor. Contrast the strength of the two under a fire. If an inch is burned off from each side of the large beams used in mill construction, three-fourths of the strength is left, while if this same amount is burned from the joists, there is nothing left. In the joisted construction there is two or three times as much wooden surface exposed to the fire as under the mill-construction method.

Beware of *temporary* light frame buildings. Every insurance man knows that buildings so designated stay in service until they burn or are about ready to fall down. Not only are these structures poor risks in themselves but they frequently constitute a menace to neighboring property. If it is really thought that eventually a building will have to be removed to make way for some other unit, expanded metal and cement on iron framing will give satisfaction at moderate expense.

In old mills steep joisted roofs supported by trusses are sometimes found on buildings otherwise well constructed. Their use was dictated doubtless by the lack of satisfactory coverings for flat roofs. These steep roofs of light construction have proved to be fire traps, and it is worth while to replace them with flat mill construction, the gain in floor space alone being often sufficient recompense for the outlay.

Hollow tile is a poor material for building walls. When subjected to a fire the rapid heating of the exposed face of the tile causes it to expand and break away from the cooler portion.

The use of double floor beams has frequently been resorted to, but this should be avoided wherever possible. If they are located an inch or two apart it leaves a space where, experience shows, it is difficult to extinguish a fire. On the other hand, if the beams are bolted together the possibility of dry rot is increased.

Fire walls should not be omitted because a good protective equipment is to be provided. The protection may be out of service when a fire starts, on account of repairs or accident, and strong fire walls are needed to minimize the possibility of a total loss.

In recent years there has been more or less trouble because of dry rot or fungus growth, due to an inferior quality of wood. Timber so affected ignites more easily than sound wood and falls more quickly in event of fire on account of the rotting away of the ends. This disease is most likely to be found in damp places and investigations show that trouble from this source can be largely eliminated. Much good results from heating a building to a temperature of 115 deg. fahr. for a day or two as soon as it has been completed, and for wet occupancies, soaking the timber in a solution of corrosive sublimate is well worth the expense.

Occupancy

The arrangement of processes carried on in a manufacturing plant must meet two requirements: efficient production and the safety of the factory. This means, so far as possible, eliminating causes of fire and preventing small fires from becoming large ones.

Isolation of Severe Hazards. The first move is to locate the departments in which fire or explosion hazards are known to be serious in detached or well-cut-off buildings. This means boiler rooms at any plant, picking rooms of textile mills, the japanning room in a metal-working shop, the engine-testing room in an automobile factory, the dipping rooms in agricultural-implement plants, etc. In cities it is not always possible, on account of limited amount of land available, to provide separate structures to house these special hazards, and they are necessarily located in main buildings. In such cases it is well to fireproof the ceilings with metal lath and cement and separate the rooms from the main rooms by fire-retarding walls.

A point that should not be overlooked is that processes requiring materials or machines susceptible to water damage should not be located under rooms where fires are likely to occur.

Storage. A fire in a manufacturing building should involve only the stock that is in process of manufacture at the time. To accomplish this separate buildings are needed for storage of raw materials, finished goods, patterns, etc. The floor area of such structures should not be large and the buildings should be the equivalent of substantial mill construction. They should be only about eight feet from floor to floor in order that stock cannot be piled high, making it impossible for hose streams or sprinklers to do effective work.

Waterproof floors are desirable for some occupancies. For mill construction these may consist of two-ply felt laid between plank and wearing surface and mopped thoroughly with a waterproof compound, with special provisions at the edges and columns. Scuppers should be provided for carrying off the water. Where separate buildings for storage are not possible, the storage may be placed in the upper stories, as it is not then subjected to water loss if fires start in the manufacturing rooms, where fires are more to be expected than in storage areas. If it is necessary to locate storage in the lower part

of a building, the floors above can be waterproofed as just described.

Oils. The danger which fuel oils bring can be offset in a great measure by careful handling. Storage should be in underground tanks and delivery by pumping. Gravity feed is highly objectionable, as is also air pressure for forcing the oil from the storage tanks. Wherever possible, gasoline should be handled by a hand pump. Fig. 1 shows a safe arrangement where the oil is to be delivered to an upper story. Fuel oil is best delivered to the burners by a rotary pump, which can be driven by the same power that operates the blower furnishing the air for atomizing, insuring the automatic cessation of the flow of oil in case of failure of the air supply. The furnaces should be located in one-story buildings well cut off from the main plant.

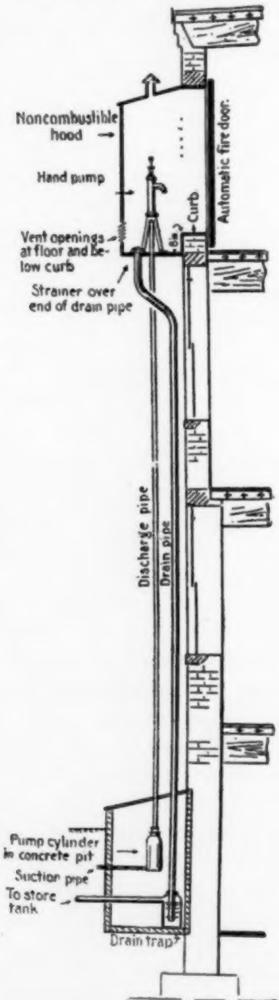


FIG. 1 ARRANGEMENT FOR FORCING GASOLINE TO AN UPPER STORY

Quenching-oil systems used in heat-treating plants have received considerable attention during recent years. A cooling system is desirable to keep the temperature of the oil below its flash point. Automatic covers and a quick-acting valve for drainage purposes are practical safeguards that are often neglected in oil tanks.

Kerosene has been used to a considerable extent in cutting oils. This introduces an unnecessary hazard, as careful investigations show that the work can be done as efficiently by emulsions or by selecting the right kind of oils. In a test made a few months ago a pan 30 in. by 48 in. was filled with straight cutting oil, and a bunch of cotton waste placed in the center and lighted. After 35 min. the fire had not spread from the waste to the oil. The same test was made with a mixture of 25 per cent kerosene and 75 per cent cutting oil, and in less than 4 min. the fire had spread over the pan.

Celluloid, although not an oil, needs as careful treatment. Burning celluloid is really a gas fire and needs to be treated as such. The amount in a factory should be limited to a day's supply, and this should be stored in a non-combustible cabinet such as that shown in Fig. 2, well vented to take care of the rapid generation of gases.

Housekeeping. A clean factory is essential. Waste materials must be removed daily and attention given to towers, corners, and out-of-the-way places. The advisability of keeping oily waste in metal cans is now generally recognized. A common source of trouble is from stock in contact with steam pipes. Charcoal is subject to spontaneous combustion and a piece of wood charred from long contact with a steam pipe will ignite. The best place to locate heating pipes is overhead. It is a bad practice to use sawdust on floors to absorb oil because of the danger of rapid oxidation.

PROTECTION

Automatic Sprinklers. The foremost method of factory protection is the automatic sprinkler, which is simply a ½-in. opening with the valve held closed by various arrangements of links and levers and operated by the melting of a fusible link. A sprinkler was developed in 1875 that operated automatically in a practical way, although it took several minutes to work. Before that period perforated pipe protection, in which the pipes were perforated by small holes about eight inches apart, was in use. In case of fire it was necessary to open the valve controlling the water supply. This did not really meet the need because of delay in getting the water on the fire, and the wetting down of the entire room. This led to the development of the automatic sprinkler equipment, a sort of combination of the perforated pipe system and the fire-door-link principle.

An ideal arrangement of piping for a sprinkler system is shown in Fig. 3. This calls for a central feed and short branch lines. These two points are important because friction loss has to be reckoned with and it counts up fast in view of the large amount of water used. The sketch shows an equipment of 200 heads.

With the inlet from the yard main coming in at the center of the building, and assuming that all sprinklers are opened, 2700 gal. of water would be required and a pressure in the street pipe of 78 lb. If the riser is located in the corner, 3400 gal. of water and a street pressure of 119 lb. are necessary in order that the end head may have a fair working pressure.

At the beginning automatic-sprinkler protection was applied mostly to the danger points in textile mills, but gradually the mills became 100 per cent protected and the use of sprinklers was taken up by other industries.

Storehouse properties were the last to receive protection, as many of these structures are not heated, and this led to the development of the dry-pipe system, in which the danger of trouble by freezing is eliminated by permitting the pipes in the building to be filled with air. When a fire starts, the pressure in the piping is reduced as the air discharges through the sprinklers that have opened, and tripping of the air valve follows promptly, letting water into the system. This apparatus was viewed with suspicion for a time, but is giving a good account of itself and is now freely used.

The fact that a building is of non-combustible construction

is no excuse for the omission of sprinkler protection, and experience has shown the need of this wherever combustibles are present in the construction or contents. In very rare cases sprinklers may be safely omitted. Power houses and foundries, unless there is an objectionable amount of wooden flasks, fall in the class where it is sometimes logical to omit sprinkler protection if the construction is non-combustible.

One sprinkler under conditions as they are found will protect from 60 to 100 sq. ft., depending on the occupancy, spacings of beams, and water pressure available. For some very special hazards extra sprinklers are needed. Celluloid is one of these, requiring a spacing so close that shields have to be provided to prevent one sprinkler from playing on its neighbor and keeping it from operating. Generally sprinklers are so located that the splash plates come from 3 to 10 in. below the ceiling and under ordinary conditions are in an upright position. This enables the system to be completely drained in case of need and gives no chance for the head to become a small settling basin, as it would be if inverted. Sprinklers in dry-pipe systems should never be placed pendant. In rooms where conditions are favorable for corrosion, heads with a coating to prevent or retard this action can be secured.

Water Supplies. The value of sprinkler protection is largely governed by the strength of the water supply. This was curiously brought out by the Salem conflagration. A wooden factory building that passed through the fire had complete sprinkler protection supplied by city water and a 30,000-gal. tank. After water from the tank was exhausted the top story burned, but the city pressure was just sufficient to save the two lower stories without any assistance from the fire department. A specimen fire-protective layout is shown in Fig. 4. A connection with a good public water system gives the most satisfactory primary supply. Gravity delivery is best, while direct pumping systems must be looked on with suspicion. Sprinklers are most useful at the start of a fire and must have water instantly to do their work, a requirement which the direct pumping systems frequently do not meet. The initial pressure available is not of great interest, but we do need to know what the effective pressure will be if sprinklers requiring 1000 gal. of water or more a minute are opened by a flash fire.

When a satisfactory water supply cannot be obtained from a public water system, the customary resource is a gravity tank preferably erected on a steel trestle in the yard, but sometimes supported by one of the building towers.

The best of public water systems or gravity tanks are out of service at times to permit repairs or extensions, and while the gravity water supply may give sufficient pressure for sprinklers, it is not always strong enough for high-pressure hose streams; or, again, pressure in the public water mains may be reduced by use of hose streams, leaving nothing for the sprinklers. Therefore, a second water supply is required for the average factory. This frequently consists of the combination of the above two sources of gravity supply, but if conditions make it feasible, an Underwriter fire pump taking suction from some river, harbor or artificial reservoir built in the factory yard is still better. Steam, rotary, and centrifugal fire pumps have been designed especially for fire service. They are not built to obtain a high efficiency, although there are certain requirements in this respect, but the chief object is to secure a rugged pump that can be counted on for a long run. One or two pumps are needed, depending on the conditions and size of plant. In this connection it is well to remember that two 750-gal. pumps give a greater degree of safety than a 1500-gal. unit, as in case of accident to one of them the plant is not entirely without fire-pump service. The standard sizes of fire pumps are 500, 750, 1000, and 1500 gal. per min.

The type of pump to be used will depend largely on the power available. Rotary pumps are usually driven from water wheels, and if these are used there must be assurance that the power can be counted on the year round. If steam pumps are employed the power house must be cut off from the main plant by a fire wall, otherwise it might not be possible to run the boilers in case of fire; also the boiler feed should be from two independent sources, possibly one of them direct from the fire pump for emergency use only. The centrifugal fire pump

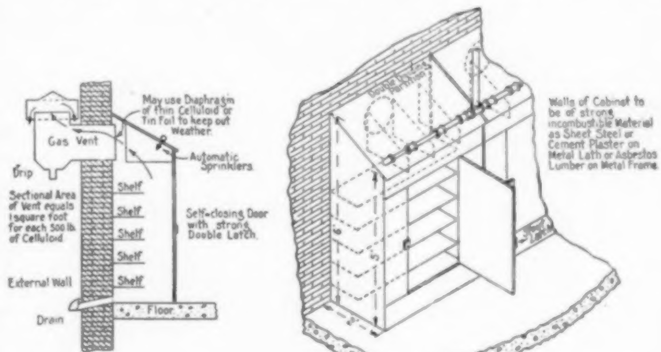


Fig. 2 Non-Combustible Cabinet for Storing Celluloid

is ordinarily driven by a motor. The current for power must be good and, unless there are some particularly favorable conditions, it needs to come from two independent sources to be the equivalent of the steam-pump equipment.

A fire pump must have a good foundation and good suction and it will then do reasonably well under very adverse conditions, but it is unsatisfactory if these two items are neglected. Long suction lines should be avoided and the intake defended by double removable screens. Centrifugal pumps should take water under a head if possible, but when this cannot be arranged priming facilities will have to be very carefully worked out and a foot valve of good design provided

Yard Pipes, Hydrants and Standpipes. The pipes must have sufficient capacity to carry all the water available to any point in a factory yard without excessive friction loss, or at least as much water as will be needed to supply both sprinklers and hydrants for the property to be protected. Six-inch pipe is the smallest that should be used. For a factory of moderate size an 8-in. loop is usually sufficient, but for large properties pipe 12 in. or more in diameter is often required.

It is true that water can generally be used to the best advantage through the sprinklers, as these put it directly on the fire, while only a small portion of water from a hose stream might reach a fire. Nevertheless hydrants are needed as a reserve because a number of accidents might happen to the sprinkler system. Where yard room permits, hydrants should be located 40 or 50 ft. from the buildings, and should be in sufficient number so that hose lines over 150 or 200 ft. long will not be required. Faith should be placed in the sprinklers and the large hose stream not brought into use until it is certain that it is needed.

Hose for outside use in mill yards should be $2\frac{5}{8}$-in. cotton, rubber-lined. This should be kept in well-ventilated houses erected over the hydrants, which should also contain a supply of nozzles, spanners and similar equipment. The nozzles should have $1\frac{1}{8}$-in. smooth tips and swivel handles. Shut-off nozzles are not recommended for factory fire brigades.

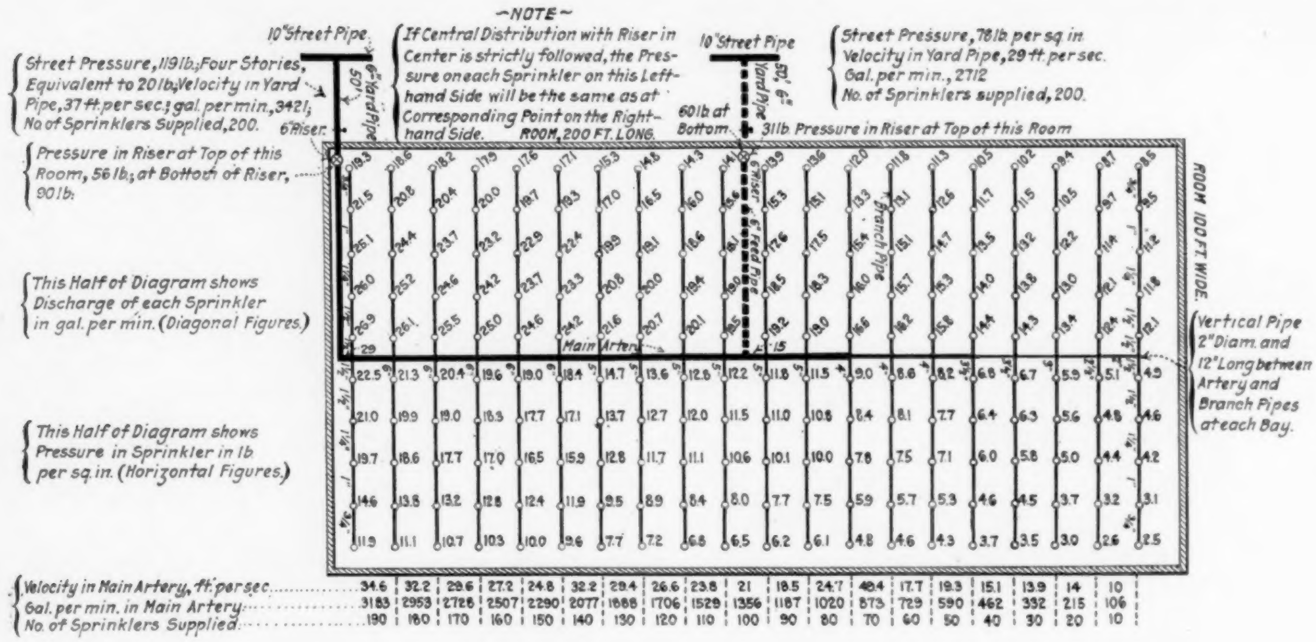


FIG. 3. IDEAL ARRANGEMENT OF PIPING FOR A SPRINKLER SYSTEM

Piping by schedule of November 1895, with new piping and central distribution. Figure shows water pressure that must be maintained at each sprinkler in room, if all the sprinklers are open, for the sprinkler in the farthest corner to receive an efficient supply.

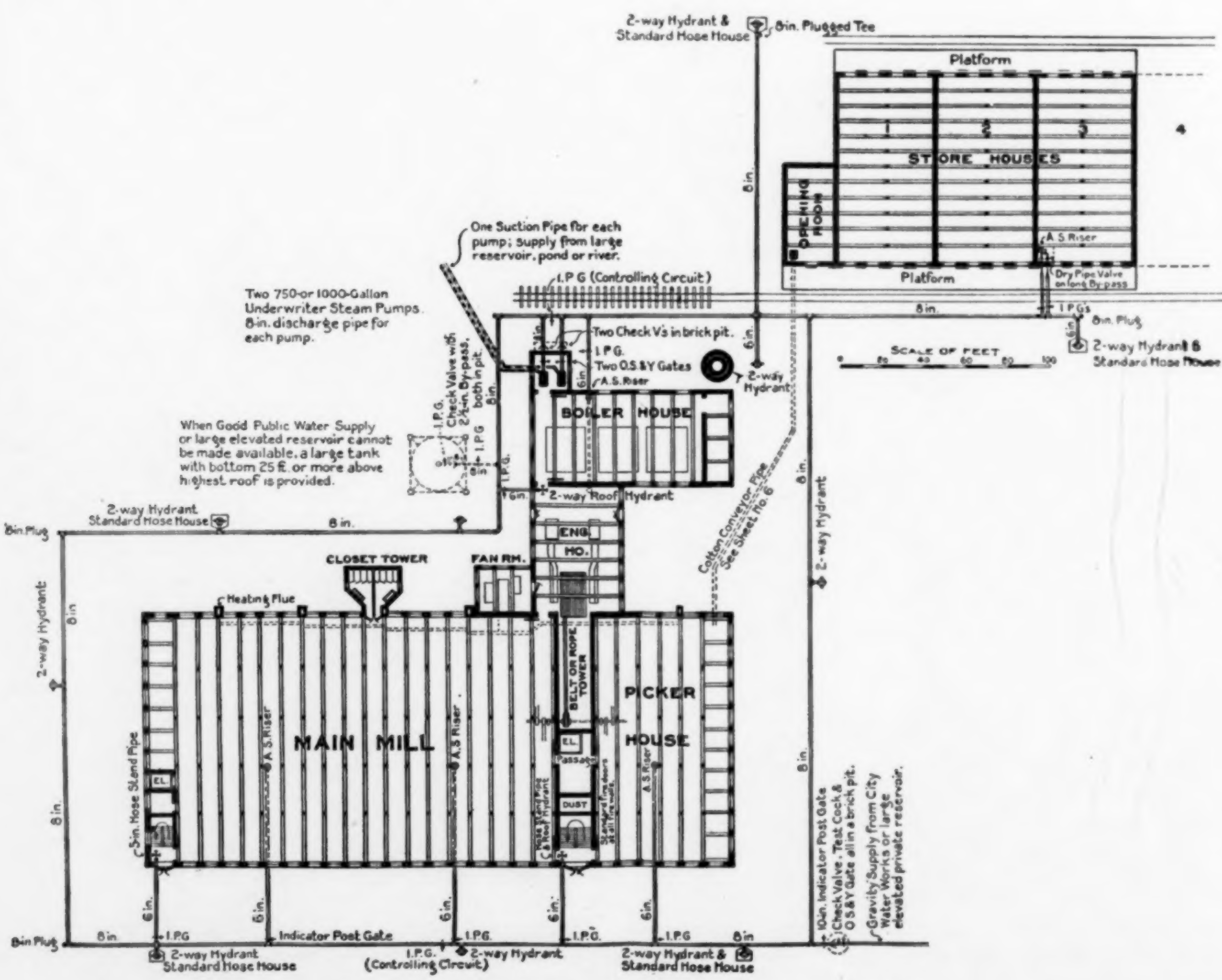


FIG. 4 SPECIMEN LAYOUT OF FIRE PROTECTION FOR A MILL

For buildings several stories high, hydrants should be supplemented by hose standpipes in the towers with 2⅝-in. hose connections at each floor. Where there are other buildings in the yard, it is an advantage to extend the standpipes through the roof and provide roof hydrants. The towers are suggested as the best locations for the standpipes, as then a fire can be fought to the last minute without running a chance of having to leave without shutting off the water. Linen hose should be used for inside work, as the rubber-lined deteriorates rapidly when kept in warm rooms.

Indicator post valves in the yard should be placed on the branches supplying sprinklers. Inside valves should not be employed as their use is likely to prove disastrous in two ways: First, a fire may happen when the valve is closed and inaccessible because of fire or smoke; second, a fire may have gone beyond control by the sprinklers, or the sprinkler piping may have been broken, and unless the controlling valve can be reached the entire water supply may be wasted through the open pipe. A few section valves in the yard mains, to permit repairs to be made without shutting off the entire protective equipment, are worth while.

First Aids. It is claimed that the water pail has put out more fires than any other extinguishing apparatus, and it should not be omitted. Any man, woman or child knows what it is for and can use it. Small hose is also very useful and should, wherever possible, be attached to some pipe system other than that of the sprinklers. The ordinary liquid extinguisher gives good service. It is better than the fire pail for some conditions, such as fires in concealed spaces and in buildings where all there is to burn is the ceiling and this is too high above the floor to be reached by water pails. Generally speaking, however, the water pails are to be preferred. Dry-powder extinguishers have usually not proved as efficient for general duty. Comparatively recent investigations show that fires in dip tanks of moderate size can be handled more easily by use of sawdust than by sand because the sand sinks, but sawdust will float, forming a blanket which excludes the air. The efficiency of this method is increased by mixing sodium bicarbonate with the sawdust.

Watchman. For more than half the time the factory is in the hands of a watchman. This duty should not be given to an old employee in lieu of a pension, but to a strong man with ability to think quickly. It is desirable that records be made of the rounds on a suitable clock, and rounds should be made as often as once an hour, and should be arranged for at all times when the factory is not in operation.

Fire Brigade. An efficient, well-organized and drilled fire brigade is also essential for city properties, as well as isolated plants, for in any plant a certain number of men must be fully acquainted with the fire-protective equipment, and there is no better way to arrange for this than by means of a fire brigade. Again, there is the possibility that the public fire department may be busy fighting a large fire at some other point when a fire breaks out in a given plant. Frequent inspections by the chief and members of the public fire department should be encouraged, as by doing this they can become acquainted with the hazards and with what help the plant can be counted upon to give to control a fire. Unquestionably there are a large number of fires that should be handled by the men at the plant, who are entirely familiar with the processes and know fully what they have to contend with.

Care of Equipment. The greatest danger to a factory built and protected along the above lines is the possibility that the protective apparatus may be out of commission through neglect, accident or malicious design. The duties of the members of the fire brigade should therefore include an efficient oversight of the protective equipment. Every attention should be given to sprinkler valves, which should be listed on a report blank, and a copy of this taken when a tour of inspection is made. When protective equipment is necessarily shut off for repairs a member of the fire brigade should be stationed at the closed valve ready to open it if a fire breaks out, and other members should patrol the areas without automatic protection.

Exposures

Dangers that there may be from outside sources must be analyzed and safeguards provided. Outside hazards may consist of some fire trap only a few feet away, may be the possibility of a general fire in the section in which the factory is situated, may come from a forest, or may even appear by water if there happen to be some large oil tanks upstream. Of course, good building laws and their enforcement are fundamental aims. Perhaps this problem would not be so serious if we had the old French law making a property owner responsible for the damage done to his neighbor's property resulting from a fire originating in his own.

The best safeguard to minimize this danger is a solid brick fire wall on the exposed side. Good protection may be had by means of tin-clad wood fire shutters—never iron ones—by wire-glass windows in metal frames, by an equipment of open sprinklers over the windows to give a water curtain, or, for severe cases, by a combination of two of these methods. Combustible cornices should be removed or protected by open sprinklers, and there should be no wooden roof structures.

It is to be anticipated that the pressure in public water systems will fall off rapidly in a general conflagration because of waste through broken pipes in addition to the water used for fire fighting. It is very important, therefore, that the private fire-pump service be very strong where the exposures are severe, in order that there may be sufficient water available for hose streams, inside sprinklers and the water curtains. Much has been accomplished along this line by adjoining factories cross-connecting their fire-protective piping, making it possible to concentrate the pump service of all at any point. Private fire protection of this kind is a help to the community in checking the spread of a conflagration.

Conclusion

Does it pay to protect factory properties against fire loss or interruption to production because of fires? Two facts will be sufficient answer. The methods described are substantially the basis on which the New England factory mutual fire-insurance companies have been operating since their organization. Fifty years ago, before the day of automatic sprinklers and development of other fire-protective methods which we have been considering, the average cost of insurance in the Blackstone Mutual Fire Insurance Co.—one of the factory mutuals—was $650 a year for $100,000 insurance. Today, for the two companies in the Blackstone office, it averages less than $65 for the same amount. Otherwise expressed, the fire waste in factories so protected and maintained has been reduced 90 per cent!

The methods of fire protection that have been applied have been as successful in safeguarding lives as property. Insurance amounting to over four billion dollars is now carried in the Factory Mutual Companies, which means that there are many hundred thousands of employees in the factories under their jurisdiction. The loss of life since automatic sprinklers were developed has averaged about one every other year!

SOME FACTORS IN FUEL ECONOMY IN BOILER PLANTS

By ROBERT H. KUSS,[1] CHICAGO, ILL.

THE total bituminous coal production in the United State during 1917 was close to 542,000,000 tons, and in the same year 90,000,000 tons of anthracite were marketed. The uses to which the bituminous coal was put have been estimated as given in Table 1. Forty per cent of the anthracite production was consumed by locomotives, and the remainder mostly by domestic users.

TABLE 1 BITUMINOUS COAL CONSUMPTION IN THE UNITED STATES, 1917

Kind of Plant	Tons	Per Cent
Stationary steam	215,000,000	40
Railway locomotives	190,000,000	35
Households	135,000,000	25
	540,000,000	100

It is easy to see from Table 1 that 60 per cent of the total coal production in the United States during 1917 was applied to non-productive uses: namely, 35 per cent for steam locomotives plus 25 per cent for household use; or, to put it more strikingly, while the railways hauled all of the coal output it took 35 per cent of the coal production to conduct the entire business of hauling. Although impossible to form a coal budget for 1918, competent authorities seem to agree that the production must be increased by not less than one hundred million tons of bituminous coal.

Much needless transporting of coal has been practiced, and therefore the Fuel Administration's order restraining coal shipments within areas of natural consumption was good judgment. The hardships follow owing to the necessity of using a grade or quality of coal in equipment designed for a more distant product. This of course is particularly evident in the domestic field where West Virginia coal has been shipped in vast quantities to the larger population centers at a considerable distance.

With a fixed system for transporting coal and with added demands for its use, it is manifestly necessary to transport all coal possible during the summer months, thus compelling storage in vast quantities. The difficulties of storage, such as the likelihood of spontaneous combustion, are well understood and can be avoided.

While it is not possible to fix a definite figure or even range representing the ratio of heat absorption to that of possible heat evolution, or, stated otherwise, the efficiency, for the respective groups of manufacturing, locomotive and domestic use, it is nevertheless desirable to look into this phase of the matter. The average estimates which appear in Table 2 are accordingly submitted by the writer for what they are worth and have to do with the performances of the several groups applied to a year's period, all losses being charged.

Granting that all of these figures are merely speculative, they still show that the largest possibilities rest within the province of the duties naturally supervised by men such as ourselves. With respect to the large avoidable losses in burning domestic fuel, it must be borne in mind that even were the reclamation or saving of coal by more economical use larger than the estimates in Table 2 indicate, the difficulties attending a proper dissemination of knowledge to effect the possible economies are extreme.

Dealing with a single furnace the particular features needing consideration are:

a The character and physical condition of the coal
b The manner of introducing the coal into the furnace
c The shape, size and construction of the grate
d The shape and size of the chamber in which evolved gases burn
e The facilities for introducing air either through or above the fuel bed.

Any means which tend to cause the gases of combustion to be evolved or distilled uniformly are in the direction of complete combustion, and this is especially affected by the character of the coal and the method of introducing it. Manifestly, with a uniform gas distillation the cubical capacity of a furnace need not be as large as for variable distillation to obtain the same effect, for the determining factor in the complete distillation of fuel is sufficient air adequately mixed with the evolved gases and maintained at a high temperature long enough to insure the completion of the combustion process before encountering relatively cool surfaces.

TABLE 2 ESTIMATED PERCENTAGE EFFICIENCIES WHEN USING BITUMINOUS COAL

	Stationary Plants		Railway Locomotives	Domestic
	High-Pressure	Low-Pressure		
Poor practice	50	40	60	30
Fair practice	64	56	66	40
Good practice	72-74	62	70	50
Available practice	76	68	72	55
Available increase	12	14	9	15
Available savings, tons	25,800,000		17,100,000	20,250,000
Total tonnage saving on 1917 basis				63,150,000

Air that does not enter into the actual combustion process is a source of loss whether the process is complete or not. Complete combustion does not argue economy, for the air admitted to bring it about may, and frequently does, exceed the amount required and be introduced in such places or in such ways as to offer itself as a vehicle for absorbing heat without assisting in its generation. Fundamentally, then, the items of importance are the rate and degree of uniformity of gas distillation. The usual failures in these particulars are due to the fact that the grate surfaces employed and air facilities provided are disproportionate to the steam demands, thus resulting in improper fuel beds and making it extremely difficult to cause the furnace to function as stated. Such conditions result in oversupplying air in certain sections, undersupplying it in others and in failing both to mix the air and gases and maintain them at a high temperature within the capacity of the furnace.

Referring to a particular design and condition of equipment, it happens that boilers perform at about the same efficiencies throughout their ranges of duty. In other words, clean, enclosed heating surface will absorb about the same

[1]Consulting M.E., Mem.Am.Soc.M.E.

Abstract of paper on the subject of coal conservation presented before the Detroit Section of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, May 3, 1918.

percentage of heat without regard to the quantity supplied to it within the range commonly encountered in practice, say, up to 250 per cent of builders' rating. This does not mean that all boilers are equally good or equally good heat absorbers; it has to do with the proposition that for a given design or shape of heating surface it is not essential to be concerned with the amount of heat delivered to envelop it, for the proportion absorbed will be practically the same in any case. On the other hand, the conditions surrounding boilers do play a big part in the resulting efficiencies and divide themselves mainly into cleanliness of both sides of the heating surface and the condition of the enclosing structure or setting of the boiler.

Boiler and furnace efficiency depend on the manner in which draft facilities are provided and utilized. In connection with draft there are the following points to bear in mind:

1 There must be provided a surplusage of draft intensity capable of being exerted at the fuel-bed end of the installation, so that momentarily greater steam demands may be met or temporary faults of fuel-bed construction overcome

2 Good judgment demands that the chimney or fan shall not have its purposes partially defeated by tortuous, ill-shaped breechings or faulty passages through the settings

3 Not only must the facilities for creating air movement through the fire be adequate, but the room delivering air to the system must have provision for the introduction of the volume of air needed for the combustion processes

4 Causes which tend to reduce draft intensity, as by soot deposits and air infiltration, not only bring about losses of their own accord but tend to destroy the available elasticity of furnace operation, which is more serious

5 Furnace draft should at all times be ample to overcome the resistance of the fuel bed

6 The rate of failure of furnace parts is inseparably tied up with the ability of the draft forces to carry away the heated gases as rapidly as evolved.

When several boilers are combined for service, there is usually a wide choice given in selecting the number to be run. Assume an ordinary plant containing eight 400-hp. boilers equipped with stokers adapted to the fuel being supplied. Suppose the draft facilities are ample and the load variation between 2500 and 2800 hp., momentarily going as high as 3000 hp. By ample draft is meant sufficient to burn without serious furnace injury enough coal (or more) on each grate to generate 760 hp. or 90 per cent overload. The ordinary way to run the plant would be to place six or seven boilers in service, keeping two or one down for general cleaning, and meet the load changes by altering damper positions, grate speeds, etc.

In Fig. 1 the line *AA* represents what may be termed the maximum combined efficiency over the range of operating rates. The mere fact that it is possible to attain these efficiencies at the different ratings does not secure their attainment. As a matter of fact, the lower the rate of operation the greater the opportunity for improper draft adjustments, poor fuel beds, uncleanliness and air leakages to go on unchecked and uncorrected. The effect is to obtain on the average a performance somewhat as represented in the efficiency curve *BB*. This has the characteristic of rising to a maximum height between 150 and 160 per cent of boiler rating. The conclusion is that it is best to run the boiler at around 150 and 160 per cent for normal loads.

Applying this judgment to the problem, take 2650 b.hp. as the mean point of service demanded and divide by 640, the latter figure being the product of 400 and 1.60. Thus four boilers will ordinarily carry the load if means are taken to operate the units at this rating. Now, how shall the momentary loads beyond be handled? By bringing up one unit at a time to its maximum capacity as the load increases up to the 3000 hp. of the original problem. In a like manner, when the load decreases, first one unit is reduced to, say, 110 per cent of rating, and if that reduction is not enough, a second unit is taken in hand, and so on. In other words, here is an attempt to push the operating forces to a place where they dare not neglect their duties lest they lose their grip on the steam pressure. When it is considered that fewer units are being

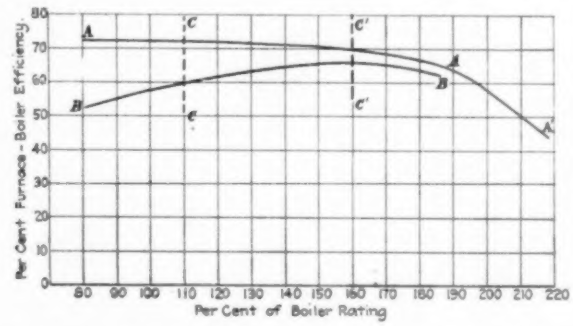


Fig 1 Effect of Various Ratings of the Boiler on Combined Efficiency

AA Available efficiency.
BB Usual operating efficiency.
CC—C'C' Proposed range of operating units.
C'C' Proposed rate of operating units for normal loads.
AA' Drop in efficiency due to insufficient furnace capacity.

watched and less fuel is handled, the net result is favorable to the operatives. The scheme advanced has many advantages for its application, as borne out by experience.

The above is a mild case and thus far only the immediate benefits in the way of economy have been stated. The corollary benefits no less important are: less blowing down; less soot accumulation and less effort and steam for its removal; less brick maintenance per ton of coal burned; less coal loss at the closing periods of the operating day and at other slowdown periods; greater time for inspection, overhauling, cleaning and repairs; and less percentage loss due to unavoidable losses such as radiation.

The ability to apply this system to its logical and best conclusion depends upon whether the available draft is adequate. If deficient, thus not permitting the attainment of a curve such as *AA*, then the opportunity for effecting the larger efficiencies is excluded, but the principle is still applicable. If the furnace capacity is inadequate, thereby causing its efficiency to fall rapidly at the higher rates, then the limits through which the scheme can be successfully applied are correspondingly reduced. If the plant is hand-fired (or even stoker-fired) and has less units than that mentioned in the problem, perhaps the exclusion of one whole unit may be impracticable; in that case each grate size should be reduced. Naturally it is extremely important to know just what the possible performance of each boiler unit may be throughout its range of working; also, what is expected of the plant as a whole in the way of steam demands.

Few instruments are needed for an ordinary plant, but those must be regularly used and the records reviewed and studied. Every boiler setting should have a draft gage or draft-gage system capable of instant or constant indication of boiler uptake and furnace drafts, and there should be accurate water-measuring and coal-weighing apparatus. Each chief engineer of a plant of, say, 600 b.hp. should possess a standard Orsat or gas-analyzing set and an indicating pyrometer.

REPORT OF THE COMMITTEE ON STANDARDIZATION OF FLANGES AND PIPE FITTINGS

To the Council of the American Society of Mechanical Engineers:

Your Committee on the Standardization of Flanges and Pipe Fittings has agreed on the following additions to existing standards comprised in its report known as The American Standard for Pipe Flanges, Fittings and Their Bolting, issued in 1914, and herewith presents them for your consideration and action:

Standardization of angle elbows and special angle fittings: From 1 deg. to 45 deg., use center-to-face dimensions of standard 45-deg. elbows, American Standard, and over 45 deg., use center-to-face dimensions given for 90 deg. American Standard elbows.

The following new standards have also been agreed upon:

1 A standard to be known as American Low-Pressure Standard for 50 lb. working pressure, tabulation of flange data at-

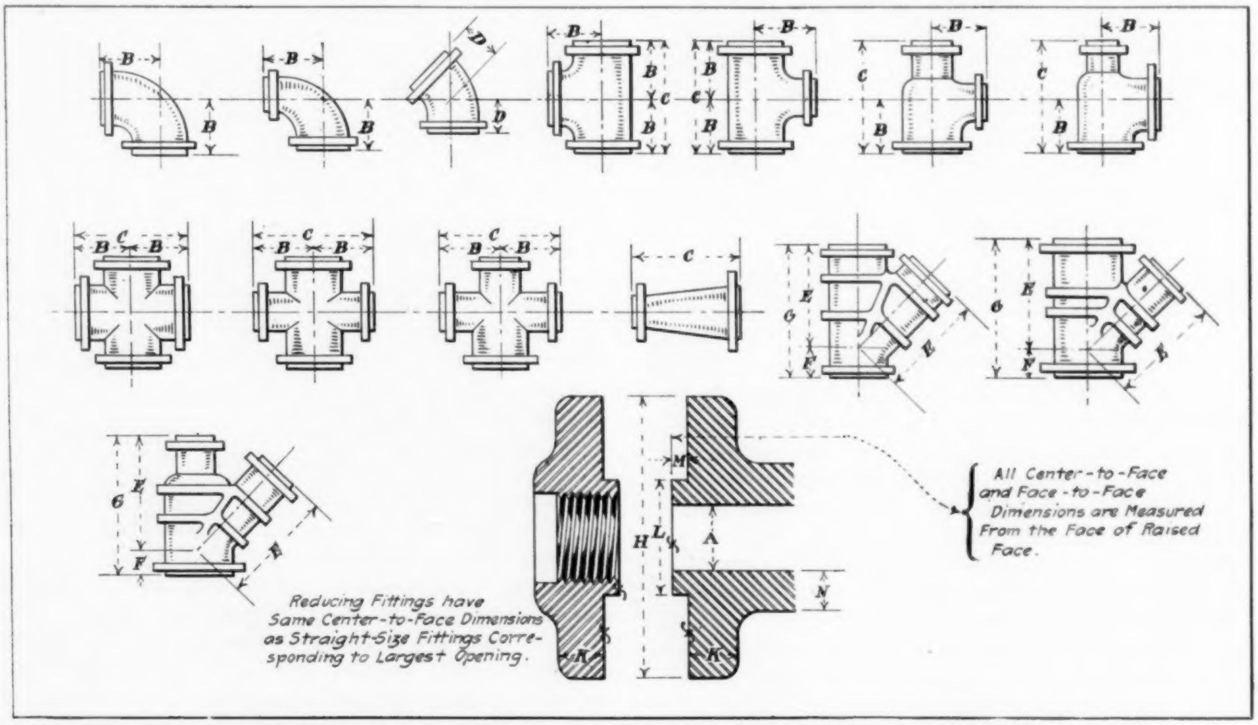
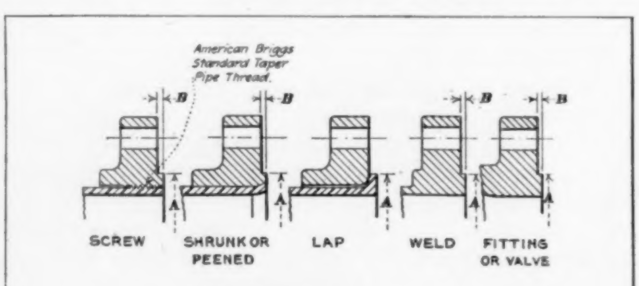
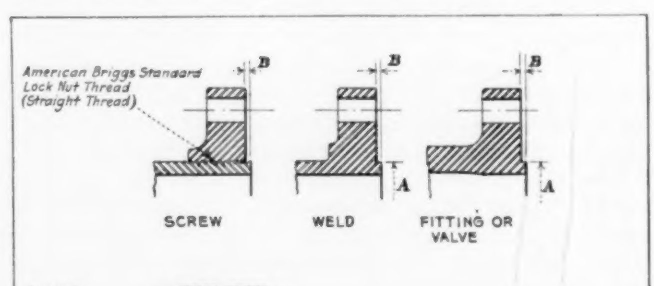


Fig. 1 Hydraulic American Standard Flanges and Flanged Fittings Dimensioned in Tables 2, 3 and 4



SIZE	A	B
1/2	1 3/8	1/4
3/4	1 11/16	1/4
1	2	1/4
1 1/4	2 1/4	1/4
1 1/2	2 7/8	1/4
2	3 5/8	1/4
2 1/2	4 1/8	1/4
3	5	1/4
3 1/2	5 1/2	1/4
4	6	1/4
4 1/2	6 1/2	1/4
5	7 1/4	1/4
6	8 3/8	1/4
7	9 3/8	1/4
8	10 5/8	1/4
9	11 5/8	1/4
10	12 3/4	1/4
12	15 1/4	1/4

Fig. 2 Flange Joints and Methods of Attaching Flanges to Pipe, 800-Lb. and 1200-Lb. Hydraulic American Standard



SIZE	A	B
1/2	7/8	1/4
3/4	1 1/16	1/4
1	1 5/16	1/4
1 1/4	1 11/16	1/4
1 1/2	1 15/16	1/4
2	2 3/8	1/4
2 1/2	2 7/8	1/4
3	3 1/2	1/4
3 1/2	4	1/4
4	4 1/2	1/4
4 1/2	5	1/4
5	5 9/16	1/4
6	6 5/8	1/4
7	7 5/8	1/4
8	8 5/8	1/4
9	9 5/8	1/4
10	10 3/4	1/4
12	12 3/4	1/4

Fig. 3 Flange Joints and Methods of Attaching Flanges to Pipe, 3000-Lb. Hydraulic American Standard

TABLE 1 PROPOSED LOW-PRESSURE STANDARD FOR END FLANGES, BOLTINGS AND BODY THICKNESS—50 LB. WORKING PRESSURE

Size	Diameter of Flange	Flange Thickness	Bolt-Circle Diameter	Number of Bolts	Size of Bolts	Body Thickness	Size	Diameter of Flange	Flange Thickness	Bolt-Circle Diameter	Number of Bolts	Size of Bolts	Body Thickness
12	19	1¼	17	12	¾	⅝	56	68¾	3	65	48	1¼	1⅝
14	21	1⅜	18¾	12	¾	11/16	58	71	3⅛	67¼	48	1¼	1⅝
15	22¼	1⅜	20	16	¾	11/16	60	73	3⅛	69¼	52	1¼	1 11/16
16	23½	1 7/16	21¼	16	¾	¾	62	75¾	3¼	71¾	52	1¼	1¾
18	25	1 9/16	22¾	16	⅞	¾	64	78	3¼	74	52	1¼	1¾
20	27½	1 11/16	25	20	⅞	13/16	66	80	3⅜	76	52	1¼	1 13/16
22	29½	1 13/16	27¼	20	⅞	⅞	68	82¼	3⅜	78¼	56	1¼	1⅞
24	32	1⅞	29½	20	⅞	⅞	70	84½	3½	80½	56	1¼	1 15/16
26	34¼	2	31¾	24	1	15/16	72	86½	3½	82½	60	1¼	1 15/16
28	36½	2 1/16	34	28	1	1	74	88½	3⅝	84½	60	1¼	2
30	38¾	2⅛	36	28	1	1	76	90¾	3⅝	86½	60	1¼	2 1/16
32	41¾	2¼	38½	28	1	1 1/16	78	93	3¾	88¾	60	1⅜	2⅛
34	43¾	2 5/16	40½	32	1	1⅛	80	95¼	3¾	91	60	1⅜	2⅛
36	46	2⅜	42¾	32	1	1⅛	82	97½	3⅞	93¼	60	1⅜	2 3/16
38	48¾	2⅜	45¼	32	1⅛	1 3/16	84	99¾	3⅞	95½	64	1⅜	2¼
40	50¾	2½	47¼	36	1⅛	1¼	86	102	4	97¾	64	1⅜	2¼
42	53	2⅝	49½	36	1⅛	1¼	88	104¼	4	100	68	1⅜	2 5/16
44	55¼	2⅝	51¾	40	1⅛	1 5/16	90	106½	4⅛	102¼	68	1⅜	2⅜
46	57¼	2 11/16	53¾	40	1⅛	1⅜	92	108¾	4⅛	104½	68	1⅜	2⅜
48	59½	2¾	56	44	1⅛	1 7/16	94	111	4¼	106¼	68	1⅜	2 7/16
50	61¾	2¾	58¼	44	1⅛	1½	96	113¼	4¼	108½	68	1⅜	2½
52	64	2⅞	60½	44	1⅛	1½	98	115½	4⅜	110¾	68	1⅜	2½
54	66¼	3	62¾	44	1⅛	1 9/16	100	117¾	4⅜	113	68	1⅜	2 9/16

NOTE

1 For sizes 10 in. and smaller, use regular 125-lb. American Standard flange dimensions and templets.

2 For sizes 12 in. and larger, use 125-lb. American Standard flange diameters, bolt circles, and number of bolts, using bolt diameters as shown above, thereby maintaining interchangeability with 125-lb. American Standard flanges.

3 Screwed companion flanges should not be thinner than 125-lb. American Standard thickness.

tached. This standard was recommended after an agreement with the Committee of the Manufacturers' Association.

2 Three standards for hydraulic fittings, to be known as:

800-Lb. Hydraulic American Standard
1200-Lb. Hydraulic American Standard
3000-Lb. Hydraulic American Standard.

Tabulations and data for each of these standards with joint designs are submitted for your consideration. These are given in Tables 1 to 4 inclusive, and Figs. 1, 2 and 3.

Your Committee deems it inadvisable at this time to outline or recommend a standard for 600 lb. steam pressure with superheat, partly because there is at present no demand for fit-

TABLE 2 800-LB. HYDRAULIC AMERICAN STANDARD FLANGES AND FLANGED FITTINGS, 12 IN. AND SMALLER, FOR FULL-WEIGHT WROUGHT PIPE. SEMI-STEEL AND CAST STEEL. (See Fig. 1)

800 Lb. Cold Water Working Pressure — Hydrostatic (no shock)
500 Lb. Cold Water Working Pressure — Shock
800 Lb. Air or Gas Working Pressure — Temperature Not Exceeding 100 Deg. Fahr.

See Fig. 1	Size	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12
A	Inside diameter of port	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12
B	Center to face, ell, tee, cross	3¼	3¾	4¼	4½	4¾	5¾	6½	7	7½	8½	8	10	11	12	13	14½	15½	16½
C	Face to face, tee, cross, reducer	6½	7½	8½	9	9½	11½	13	14	15	17	18	20	22	24	26	29	31	33
D	Center to face, 45-deg. ell	2	2¼	2¼	2¾	3	4¼	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
E	Center to face, lateral	5½	6	6¾	7½	8¾	11	12½	13½	14½	16½	17½	19½	21	22½	24½	27½	29½	31½
F	Center to face, lateral	1¾	2	2¼	2½	2¾	3½	3½	4	4½	4½	5½	6	6½	6½	7	7½	8	8½
G	Face to face, lateral	7¼	8	9	10	11½	14½	16	17½	19	21	23	25½	27½	29	31½	35	37½	40
H	Diameter of flange	3½	4	4½	5	6	7	7½	8½	9½	10¾	11½	13	14	15	16½	18¾	20	22
K	Thickness of flange, Semi-steel	9/16	⅝	11/16	¾	13/16	1¼	1⅜	1½	1⅝	1⅞	2	2⅛	2¼	2⅜	2½	2¾	2⅞	3
	Thickness of flange, Cast steel	..	..	..	..	..	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2⅜	2½	2¾
L	Diameter of raised face	1⅜	1 11/16	2	2¼	2⅞	3⅝	4⅛	5	5½	6	6½	7⅛	8⅜	9⅝	10⅝	11⅝	12¾	15¼
M	Height of raised face	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
N	Minimum metal thickness, Semi-steel	7/16	7/16	½	½	½	9/16	⅝	⅝	¾	⅞	1	1⅛	1⅛	1¼	1⅜	1½	1⅝	1¾
	Minimum metal thickness, Cast steel	..	..	..	..	..	½	9/16	9/16	⅝	11/16	¾	13/16	⅞	1	1 1/16	1⅛	1¼	1⅜
	Diameter of bolt circle	2⅜	2⅞	3¼	3¾	4½	5¼	5⅞	6½	7½	8½	9¼	10½	11½	12½	13¾	15½	17	19¼
	Number of bolts	4	4	4	4	4	4	8	8	8	8	8	8	12	12	12	16	16	20
	Diameter of bolts	7/16	½	½	½	⅝	¾	¾	¾	⅞	⅞	⅞	1	1	1	1⅛	1¼	1¼	1¼
	Length of bolts, Semi-steel	2¼	2½	2½	2¾	3	4	4¼	4½	4¾	5¼	5½	6	6¼	6½	7	7½	7¾	8
	Length of bolts, Cast steel	..	..	..	..	..	3½	3¾	4	4¼	4½	4¾	5¼	5½	5¾	6¼	6¾	7	7¼

These fittings are recommended for pump columns, oil-transmission lines, gas lines and other hydraulic service where shock is negligible for a maximum working pressure of 800 lb. and a maximum temperature of 100 deg. fahr. Where subject to shock they are recommended for a maximum working pressure of 500 lb.

The diameter of port is nominal size.

Reducing fittings carry same dimensions center to face as straight-size fittings corresponding to largest opening.

Flanges may be attached to the pipe by any of the following methods: Screw flanges; lap flanges; shrunk, peened or riveted flanges; flanges welded to pipe.

Flanges on fittings and valves, also all companion flanges except those for lap joint, should be furnished with ¼-in. raised face, as shown in dimension table, Fig. 2, unless otherwise specified.

Bolt holes are ⅛ in. larger in diameter than bolts. Bolt holes straddle center lines. Unless otherwise specified, bolt holes in cast-steel fittings should be spot-faced.

Square-head bolts with hexagonal nuts are recommended. Hexagonal nuts on sizes 8 in. and smaller can be conveniently pulled up with open-end wrenches with minimum-design heads. Hexagonal nuts on sizes 9 in. and larger can be conveniently pulled up with box wrenches.

When flanges are screwed, shrunk, peened or riveted on the pipe, it is recommended that the end of the pipe and flange be refaced.

Gaskets extending from the inside of the pipe to the inside edge of the bolts are recommended. The ultimate compressive strength of the gasket must be sufficient to prevent its being crushed when bolts are pulled up.

Where long-radius elbows are desired, the use of pipe bends is recommended.

TABLE 3 1200-LB. HYDRAULIC AMERICAN STANDARD FLANGES AND FLANGED FITTINGS, 12 IN. AND SMALLER, FOR EXTRA STRONG WROUGHT PIPE. SEMI-STEEL AND CAST-STEEL (See Fig. 1)

1200 Lb. Cold Water Working Pressure — Hydrostatic (no shock)
800 Lb. Cold Water Working Pressure — Shock
1200 Lb. Air or Gas Working Pressure — Temperature Not Exceeding 100 Deg. Fahr.

See Fig. 1	Size	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12
A	Inside diameter of port	½	¾	15/16	1¼	1½	1⅞	2¼	2¾	3¼	3¾	4¼	4¾	5¾	6¾	7⅝	8¾	9¾	11¾
B	Center to face, ell, tee, cross	3½	4	4½	5	5¾	6½	7	7½	8½	9	10	11	12	13	14½	15½	16½	17½
C	Face to face, tee, cross, reducer	7	8	9	10	11½	13	14	15	17	18	20	22	24	26	29	31	33	35
D	Center to face, 45-deg. ell	2½	3	3½	4	4¼	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11
E	Center to face, lateral	7	8	9	10	11	12½	13½	14½	16½	17½	19½	21	22½	24½	27½	29½	31½	34½
F	Center to face, lateral	2	2½	2½	3	3½	3½	4	4½	4½	5½	6	6½	6½	7	7½	8	8½	9
G	Face to face, lateral	9	10½	11½	13	14½	16	17½	19	21	23	25½	27½	29	31½	35	37½	40	43½
H	Diameter of flange	4¼	4¾	5½	6	6¾	8	8½	9½	10¾	11½	13	14	15	16½	18½	20	21½	24
K	Thickness of flange { Semi-steel	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1⅞	2	2⅛	2¼	2⅜	2½	2¾	2⅞	3	3⅛
	Thickness of flange { Cast steel	..	..	..	..	..	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2⅜	2½	2⅝	2¾
L	Diameter of raised face	1⅜	1 11/16	2	2¼	2⅞	3⅝	4⅛	5	5½	6	6½	7¼	8⅜	9⅜	10⅝	11⅝	12¾	15¼
M	Height of raised face	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
N	Minimum metal thickness { Semi-steel	½	½	9/16	9/16	⅝	¾	⅞	1	1 1/16	1⅛	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2½
	Minimum metal thickness { Cast steel	..	..	..	..	..	⅝	11/16	13/16	⅞	1	1 1/16	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞
	Diameter of bolt circle	3	3⅜	4	4⅜	4⅞	6	6½	7½	8½	9¼	10½	11½	12½	13¾	15½	17	18½	21
	Number of bolts	4	4	4	4	4	4	8	8	8	8	8	8	12	12	12	16	16	20
	Diameter of bolts	½	½	⅝	⅝	¾	⅞	⅞	⅞	1	1	1⅛	1⅛	1⅛	1¼	1⅜	1⅜	1⅜	1⅜
	Length of bolts { Semi-steel	2¾	3	3¼	3½	4	4¼	4½	4¾	5½	5¾	6¼	6½	6¾	7	7¾	8	8¼	8½
	Length of bolts { Cast steel	..	..	..	..	..	3¾	4	4¼	4¾	5	5½	5¾	6	6¼	7	7¼	7½	7¾

These fittings are recommended for pump columns, oil-transmission lines, gas lines and other hydraulic service where shock is negligible for a maximum working pressure of 1200 lb. and a maximum temperature of 100 deg. fahr. Where subject to shock they are recommended for a maximum working pressure of 800 lb.

The diameter of port is approximately the same as the inside diameter of Extra Strong Pipe.

Reducing fittings carry the same dimensions center to face as straight-size fittings corresponding to largest opening.

Flanges may be attached to the pipe by any of the following methods: Screw flanges; lap flanges; shrunk, peened or riveted flanges; flanges welded to pipe.

Flanges on fittings and valves, also all companion flanges except those for lap joint, should be furnished with ¼-in. raised face, as shown in dimension table, Fig. 2, unless otherwise specified.

Bolt holes are ⅛ in. larger in diameter than bolts. Bolt holes straddle center lines. Unless otherwise specified, bolt holes in cast-steel fittings should be spot-faced.

Square-head bolts with hexagonal nuts are recommended. Hexagonal nuts on sizes 8 in. and smaller can be conveniently pulled up with open-end wrenches with minimum-design heads. Hexagonal nuts on sizes 9 in. and larger can be conveniently pulled up with box wrenches.

When flanges are screwed, shrunk, peened or riveted on the pipe, it is recommended that the end of the pipe and flange be refaced.

Gaskets extending from the inside of the pipe to the inside edge of the bolts are recommended. The ultimate compressive strength of the gasket must be sufficient to prevent its being crushed when the bolts are pulled up.

Where long-radius elbows are desired, the use of pipe bends is recommended.

tings for this pressure and because your Committee feels that it should be guided somewhat by experience in the field with the pressures and temperatures now in use, namely, 300 lb. pressure and 250 to 275 deg. superheat.

Your Committee, however, is ready to advise that for 400 lb. steam pressure and not exceeding 250 deg. superheat the 800-Lb. Hydraulic American Standard in steel is adequate.

These recommendations bring the work of your Committee up to date so far as any requests that they have before them for consideration are concerned.

TABLE 4 3000-LB. HYDRAULIC AMERICAN STANDARD FLANGES AND FLANGED FITTINGS, 12 IN. AND SMALLER, FOR DOUBLE EXTRA STRONG WROUGHT PIPE. CAST STEEL. (See Fig. 1)

3000 Lb. Cold Water Working Pressure — Hydrostatic (no shock)
2000 Lb. Cold Water Working Pressure — Shock
3000 Lb. Air or Gas Working Pressure — Temperature Not Exceeding 100 Deg. Fahr

See Fig. 1	Size	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10	12
A	Inside diameter of port	⅜	½	¾	15/16	1¼	1½	1⅞	2¼	2¾	3¼	3¾	4¼	4¾	5¾	6¾	7⅝	8¾	10¾
B	Center to face, ell, tee, cross	3½	4	4½	5	5¾	6½	7	7½	8½	9	10	11	12	13	14½	15½	16½	17½
C	Face to face, tee, cross, reducer	7	8	9	10	11½	13	14	15	17	18	20	22	24	26	29	31	33	35
D	Center to face, 45-deg. ell	2½	3	3½	4	4¼	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	11
E	Center to face, lateral	7	8	9	10	11	12½	13½	14½	16½	17½	19½	21	22½	24½	27½	29½	31½	34½
F	Center to face, lateral	2	2½	2½	3	3½	3½	4	4½	4½	5½	6	6½	6½	7	7½	8	8½	9
G	Face to face, lateral	9	10½	11½	13	14½	16	17½	19	21	23	25½	27½	29	31½	35	37½	40	43½
H	Diameter of flange	4¼	4¾	5½	6	6¾	8	8½	9½	10¾	11½	13	14	15	16½	18½	20	21½	24
K	Thickness of flange	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1⅞	2	2⅛	2¼	2⅜	2½	2¾	2⅞	3	3⅛
L	Diameter of raised face	⅞	1 1/16	1 5/16	1 11/16	1 13/16	2⅝	2⅞	3½	4	4½	5	5 9/16	6⅝	7⅝	8⅝	9⅝	10¾	12¾
M	Height of raised face	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
N	Minimum metal thickness	7/16	½	½	9/16	9/16	⅝	¾	⅞	1	1 3/16	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2⅜
	Diameter of bolt circle	3	3⅜	4	4⅜	4⅞	6	6½	7½	8½	9¼	10½	11½	12½	13¾	15½	17	18½	21
	Number of bolts	4	4	4	4	4	4	8	8	8	8	8	8	12	12	12	16	16	20
	Diameter of bolts	½	⅝	⅝	¾	⅞	⅞	⅞	1	1	1⅛	1¼	1¼	1¼	1⅜	1½	1½	1½	1½
	Length of bolts	2¾	3	3¼	3¾	4	4¼	4½	5	5½	6	6¼	6½	6¾	7¼	7¾	8	8¼	8½

These fittings are recommended for hydraulic service where shock is negligible for a maximum working pressure of 3000 lb. and a maximum temperature of 100 deg. fahr. Where subject to shock they are recommended for a maximum working pressure of 2000 lb.

The diameter of port is approximately the same as the inside diameter of Double Extra Strong Pipe.

Reducing fittings carry same dimensions center to face as straight-size fittings corresponding to largest opening.

Flanges may be attached to the pipe by either of the following methods: Screw flanges; flanges welded to pipe.

Flanges on fittings and valves should be furnished with ¼-in. raised face, as shown in dimension table, Fig. 3, unless otherwise specified.

Screw flanges are furnished with plain face and are threaded with American Briggs Standard lock-nut threads. The pipe should be threaded with American Briggs Standard lock-nut threads, and the end of the pipe should be faced off square. The pipe should be screwed through the flange until the end projects about ¼ in. beyond the face of the flange and bears against the gasket.

When flanges are welded on the pipe the end of the pipe should project through the flange and should be faced off square to form the raised face.

Bolt holes are ⅛ in. larger in diameter than bolts. Bolt holes straddle center lines. Unless otherwise specified, bolt holes should be spot-faced.

Square-head bolts with hexagonal nuts are recommended. Hexagonal nuts on sizes 5 in. and smaller can be conveniently pulled up with open-end wrenches with minimum-design heads. Hexagonal nuts on sizes 6 in. and larger can be conveniently pulled up with box wrenches.

Gaskets extending from the inside of the pipe to the inside edge of the bolts are recommended. The ultimate compressive strength of the gasket must be sufficient to prevent its being crushed when the bolts are pulled up. Soft metallic gaskets at least 1/16 in. thick are recommended.

Where long-radius elbows are desired, the use of pipe bends is recommended.

It is the desire of the Manufacturers' Association that the standards herein outlined be made effective at the earliest possible date. Your Committee, therefore, respectfully invites your early action.

Respectfully submitted,

Arthur R. Baylis, *Acting Chairman*
Stanley G. Flagg, Jr.
E. M. Herr
Arthur M. Houser
Julian Kennedy
E. A. Stillman
A. S. Vogt
W. M. White

Committee on Standardization of Flanges and Pipe Fittings

Received by the Council, April 23, 1918, and ordered printed. For presentation at the Annual Meeting, December 1918, of The American Society of Mechanical Engineers, 29 West 39th Street, New York. This paper was prepared under the direction of J. P. Sparrow, deceased, the late Chairman of the Committee. All papers are subject to revision.

THE WORK OF THE BOILER CODE COMMITTEE

The Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the Code is requested to communicate with the Secretary of the Committee, Mr. C. W. Obert, 29 West 39th St., New York City.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the Secretary of the Committee to all of the members of the Committee. The interpretations, in the form of replies, are then prepared by the Committee and passed upon at a regular meeting of the Committee. These interpretations are later submitted to the Council of the Society for approval, after which they are issued to the inquirer and simultaneously published in The Journal, in order that any one interested may readily secure the latest information concerning the interpretation.

Below are given the interpretations of the Committee in Cases Nos. 194-199, inclusive, as formulated at the meeting of July 31-August 1, 1918, and approved by the Council. In this report, as previously, the names of inquirers have been omitted.

Case No. 194

Inquiry: Is the reservoir or tank of a steam storage locomotive built with running gear exactly similar to an ordinary steam locomotive, but having instead of a boiler, a storage tank filled about 80 per cent with hot water at 180 lb. pressure, to be considered as a steam boiler and thus subject to the rules of the Boiler Code, or as an unfired pressure vessel, and thus exempt therefrom? The tank has no fire box nor staying nor other features which are responsible for corrosion and scale, and it is usually designed for a factor of safety of 4, being fitted with a safety valve of ample proportions.

Reply: It is the opinion of the Committee that the unfired reservoir of such a locomotive is not subject to the rules of the Code.

Case No. 195

Inquiry: Is it necessary, under the requirements of Par. 185, to plane down to $\frac{1}{2}$ in. on the top of the shell the portions of the plates forming the laps of girth joints of an h.r.t. boiler with setting of the third-pass type?

Reply: Par. 185 of the Boiler Code requires that the portions of plates, exceeding $\frac{9}{16}$ in. in thickness, which form the laps of girth joints in h.r.t. boilers, shall be planed or milled down to $\frac{1}{2}$ in. in thickness wherever exposed to the products of combustion.

Case No. 196
(Annulled)

Case No. 197

Inquiry: An interpretation is requested relative to the application of Par. 9 of the Boiler Code to handhole covers and plates. Are they considered as a part of the boiler proper so as to come under the requirement of Par. 9, or may they be considered as fittings and thus permissible of cast-iron construction under Par. 12?

Reply: The Bôiler Code does not prohibit the use of cast-iron for handhole plates except for certain temperature limits as specified in the Code. See Par. 12.

Case No. 198

Inquiry: Is the plain unstayed circular furnace, $16\frac{3}{8}$ in. outside diameter by 16 in. high, of a vertical tubular boiler, subject to the requirements of Par. 239 of the Boiler Code, with proposed revisions, which will allow it a reasonable working pressure, or to Par. 241*a*, which will allow it a pressure of only 70 lb.?

Reply: It is the opinion of the Boiler Code Committee that the formulæ given in Par. 239 should be employed for computing the allowable pressure of this furnace.

Case No. 199

Inquiry: Is the requirement of Par. 265 covering a wash-out hole in the front head applicable to the railroad locomotive type of boiler which is so obstructed by the dry pipe, spark arrester screen, and other smoke box equipment as to render it absolutely inaccessible without dismantling the locomotive?

Reply: It is the opinion of the Boiler Code Committee that the requirement of Par. 265 applies only to locomotive type boilers in traction, portable or stationary service and not to railroad locomotive boilers.

Case No. 190 (Reopened)

Inquiry: Is it the intention of the interpretation in Case No. 190 to include vertical firetube boilers as well as boilers of the Manning type which differ from the vertical tubular type only in the use of the Manning OG ring?

Reply: The original reply in Case No. 190 was so worded as to cover the vertical joint of any form of internal furnace where the joint is fully supported by staybolting.

Case No. 191 (Reopened)

Inquiry: Does the interpretation formulated in Case No. 191 permit the steel manufacturer to cut butt straps as called for by the customer, or if the customer expresses no preference, then to cut the butt straps in whatever direction his judgment and convenience may dictate, and make the tests from the plate as rolled, as provided in the specifications for boiler plate steel?

Reply: The steel manufacturer is privileged to shear butt straps from the plate as rolled in whichever direction the orders of the customer or the manufacturer's convenience may dictate, the tests to be made from the plate as rolled, as provided in the specifications for boiler plate steel.

The Canadian Engineering Standards Committee has been organized with official representation from the government departments, the Canadian Manufacturers' Association and several technical organizations. Its objects are to secure interchangeability of parts, to reduce cost of manufacture by the elimination of multiplicity of designs, and to effect improvements in workmanship and design.

The following officers were elected: Chairman, Sir John Kennedy; vice chairmen, H. H. Vaughan, Mem.Am.Soc.M.E., and Capt. R. J. Durley; honorary secretary-treasurer, Dr. John B. Porter; secretary, Frank S. Keith. The headquarters will be at 176 Mansfield Street, Montreal.

CORRESPONDENCE

CONTRIBUTIONS to the Correspondence Departments of The Journal by members of The American Society of Mechanical Engineers are solicited by the Publication Committee. Contributions particularly welcomed are suggestions on Society Affairs, discussions of papers published in The Journal, or brief articles of current interest to mechanical engineers.

Suggestions for the Conservation of Tin

To the Secretary:

Concerning the matter of Tin Conservation which has recently been referred to our Sub-Committee on Bearing Metals, we most heartily approve of the work already done by the various agencies in the field of tin conservation, now in general coöperation with the Government. It is evident that in order to accomplish most effective results in this field a very general whole-hearted coöperation should exist between all users and consumers of tin. Fortunately this condition is evident throughout the entire country.

We fully realize that it is impossible to lay down hard and fast recommendations to govern all cases, since so many exceptions and special requirements must always exist. We feel, therefore, that our suggestions at this time should be of a purely technical nature such as will prove of permanent and lasting value.

In general, we would call the designing engineer's attention to the fact that the tin-base babbitts are far more generally used than necessary, and that where service conditions permit the use of a lead-base babbitt, the most satisfactory results are obtained by such use.

In general, tin-base babbitts should be restricted to bearings subjected to extreme service conditions, to those under excessive loads, repeated impacts and severe shocks. However, even under these conditions it is possible to reduce the tin consumption by an improved construction in which the layer of babbitt is made thinner. This is accomplished by sweating a thin layer of babbitt into a steel backing or shell made of tubing, and thus producing a very superior construction, while at the same time accomplishing the purpose of conserving tin.

It seems advisable that the use of tin-base babbitts be restricted to those having the following two limits of composition: namely, from 0 to 21 and from 76 to 88 per cent of tin. Those falling within the lower limits should be used far more generally than those of the higher limits.

At this time, also, it seems opportune to call attention to an old bronze formula: namely, 88 copper, 10 tin and 2 zinc, commonly known as gun metal or ordnance bronze. This should be entirely superseded by a composition having substantially 90 copper, 6.5 tin, 1.5 lead and 2 zinc, which is a superior composition in every respect. In general, it is stronger and more reliable; is more economical in foundry production; is easier and more satisfactorily machined; for hydraulic work is less liable to leaks; in steam service it is from 5 to 40 per cent stronger than the old composition; while at the same time this substitute formula offers a saving of $3\frac{1}{2}$ per cent of tin, which is always wasted in the old formula incident to the production of an inferior alloy.

A copper-tin bronze having more than a minute trace of phosphorus should be used for bearing purposes only when the corresponding bearing member is made of hardened or high-carbon heat-treated steel. A copper-tin bronze containing no lead and whose tin is 9 per cent, or more than that of its copper content, should never be used with the softer low-carbon machinery steels. A copper-tin bearing bronze in which the tin is as high as 9 per cent of its copper content, or higher, and at the same time which contains zinc, should also contain lead in amount not less than its zinc content.

We would also call attention to the fact that where exacting chemical conditions and flowing requirements do not exist, solders having a low percentage of tin can be used far more generally, and in many cases even produce a superior product. The composition of 60 lead and 40 tin is the strongest and most plastic alloy of these constituents, having a melting point of 39 deg. fahr. higher than a 50-50 solder. For many purposes it has been found that the lead can be increased even beyond this point, and thereby still effect a very satisfactory economy.

Respectfully submitted,

C. H. Bierbaum, *Chairman*
J. A. Capp
H. Diederichs
Sub-Committee on Bearing Metals.

September 12, 1918.

Fuel Administration in Missouri

Prof. H. Wade Hibbard, Mem.Am.Soc.M.E., of the University of Missouri, who has recently been appointed District Engineer of the United States Fuel Administration for the North Central District of Missouri, has sent interesting information regarding his work in the district. He expresses the hope, which the editor earnestly seconds, that others who are actively engaged in the work of winning the war should contribute to The Journal accounts of their experiences.

Professor Hibbard refers to the great usefulness of Bulletin No. 1 of the Advisory Committee of the Massachusetts Fuel Administration, a portion of which was reproduced in The Journal for August, page 692. He states that his district is 140 miles long north and south, and 133 miles long east and west, with 83 public-service utilities and several times that number of other plants and factories. He is engaged in organizing the work and stimulating local patriotic sentiment along the lines of fuel and power conservation.

Every man wants to be doing something in the war and owners and operators too old or otherwise unable to "make" the Army, are still able to send substitutes to the Army. The power-plant operator or factory owner who can save one coal-miner's annual output of coal is in effect sending a "substitute" to carry a rifle *over there*. In our Civil War a man could *hire* a substitute to go in his place; but the *miner-substitute* is a very different and much finer idea.

It is expected to have fuel and power committees in each plant and an advisory committee to unify and help the work in each town, and also a county advisory committee in each county. The largest city in the county is made a conservation center.

Mr. J. A. Whitlow, Mem.Am.Soc.M.E., Administrative Engineer, is in charge of this work in Missouri. His connection for years with the public-service work forms an especially favorable circumstance for the quick and effective organization of the state, he being already personally acquainted with all of the public utilities and their operators and with most of the engineers.

ENGINEERING SURVEY

A Review of Progress and Attainment in Mechanical Engineering and Related Fields, Including Abstracts of Articles in Current Technical Periodicals

Waste Reclamation

A meeting was recently held by Hugh Frayne, member of the War Industries Board and chairman of its War Prison Labor and Reclamation Section, with various section chiefs in the War Industries Board and representatives of other agencies concerning the important matter of the reclamation of waste materials. A general plan was outlined for uniformity of method and coöperation among the various agencies in reclaiming materials much needed in the Government's war program.

As an illustration of the value of reclamation work that can be done, Mr. Frayne pointed out that during June and July 17,000 soldiers were completely outfitted with shoes, hats and clothing from material which other soldiers had discarded. All of this material was disinfected, renovated, and repaired or remade, instead of being allowed to go to the junk pile. This work was done through the reclamation division of the Quartermaster's Department, of which Col. J. S. Fair is in charge. (*Official Bulletin*, August 13, 1918, p. 15)

Plant to Make "Carbocoal"

It is stated by the Fuel Administration that the U. S. Government has become interested in the establishment of a plant at Clinchfield, Va., for the manufacture of "Carbocoal," a smokeless briquetted fuel produced from bituminous coal. This has developed as the result of tests on the briquets made by the Navy Department and two railroad companies. The plant, which is now in the preliminary stages of construction, is expected to be in operation early in 1919 and will have a capacity of treating several hundred thousand tons of bituminous coal annually.

A new process of low-temperature distillation is used by which coal is so treated as to recover greater quantities of the valuable by-products, such as toluol, sulphate of ammonia, and valuable oils. The briquets are made from the residue. Tests of carbocoal disclose that it contains less than 4 per cent of volatile matter, rendering it practically smokeless, and that it is satisfactory where there is limited grate area and restricted boiler capacity. (*Official Bulletin*, August 27, 1918, p. 8)

New Department of the Engineer Depot

Few realize the immense volume of work accomplished by the General Engineer Depot at Washington in supplying the engineering equipment required by the Army in this country and abroad. The fact that its various departments have often accomplished the seemingly impossible is indicated by the slogan of the Depot, "It can't be done, but here it is." Specifications have been issued and orders placed for supplies to the extent of $5,700,000 by a single department in a single day. The personnel of the Depot comprises a staff of 3600 situated in different parts of the country, with 150 engineers of the first class. Thirteen of the Washington staff are members of this Society.

Announcement has been made of a new division of the Depot on Investigation, Research and Development, of which Major O. B. Zimmerman, Mem.Am.Soc.M.E., is in charge, covering the following subjects: Searchlights; surveying; map production; sound ranging; engineer equipment; testing mechanical and optical devices; physical and chemical research and tests; coöperation and coördination; information sources and patents; heavy-equipment developments.

Among the functions of this division are:

1 To review, follow up and initiate improvements in the military equipment and supplies of the Mobile Army, in coöperation with purchasing officers of corresponding equipment and with cognizance of manufacturing facilities and available materials.

2 To conduct or follow chemical and physical tests of material and equipment; and to conduct efficiency tests.

3 To assist in the creation of suitable specifications and advise on technical questions.

4 To assist officers of the Depot to develop their ideas into patentable form in order to protect the Government against the payment of royalties for ideas originating in the Depot.

Prevention of Accidents in Government Nitro Plant

The United States Employees' Compensation Commission issues the following:

A remarkably low accident record has been effected during the construction of the United States explosive plant C, at Nitro, W. Va., which was begun the early part of January 1918. This is attributed directly to forethought and careful planning in the elimination of accident hazards through concerted effort in modern methods of safety engineering.

This plant covers approximately 1600 acres of land, upon which are constructed hundreds of buildings to be used in the manufacture of smokeless powder. In addition to the plant acreage there are about 900 acres of land, upon which are being constructed thousands of homes in which the operators will live.

No records in the United States accident statistical record books, past or present, have been more wonderful than those now shown at this Government powder plant, where, to date, there has been but two-tenths of one per cent of the number of working hours lost by injuries resulting from accidents causing absence of employees.

But six fatalities have occurred at this plant during the past eight months of its construction period, where upward of 19,000 employees have been working overtime and Sundays to complete this gigantic project. Only 8 accidents per 10,000 employees per day have occurred, entailing loss of one day or more.

The supervision of this accident-prevention work has been done by a well-organized safety department which, representing the United States Employees' Compensation Commission, at Washington, D. C., has been under the direction of C. B. Hayward, safety engineer in charge. Its activities, coupled with the assistance and coöperation of the officials down to the workmen, have made it possible to create this new mark in accident-prevention work. (*Official Bulletin*, September 4, 1918, p. 7)

British Scientific Products Exhibition

This exhibition was formally opened at Kings College, London, on August 14, and remained open every weekday till September 7. It was organized under the auspices of the British Science Guild with the assistance and coöperation of a large number of scientific technical societies and institutions, as well as various official and municipal authorities and various manufacturers.

The exhibition was not intended to be a direct meeting ground between purchaser and manufacturer but rather to enlighten the public as to the scientific and industrial strength and adaptability of the country, as well as to stimulate confidence in the national capacity to meet not only the needs of the present but also the demands of the future. It was intended also to make clear the value of scientific research to the arts and industries and to show how much, in this regard, had been successfully achieved since the beginning of the war, which, in many directions, revealed an appalling dependence of Great Britain on foreign products and instruments.

Many things done in the last four years could not be exhibited for reasons of military secrecy, but it proved possible to make a very good showing even in such lines, as, for example, in aeronautical progress, where military considerations are predominant. One of the difficulties encountered was to find a sufficient number of men that could be spared from actual war work and still be competent to answer questions of visitors. This difficulty was solved by making arrangements by which college students were used as demonstrators.

During the course of the exhibition lectures and demonstrations were given. Sir William Tilden spoke on Recent Progress in Industrial Chemistry and representatives of the Munitions Invention Department demonstrated the oxidation of ammonia.

Engineering, from which the above data were taken (vol. 106, no. 2746, August 16, 1918, pp. 177-178), gives an extensive serial account of the exhibition, of which the article referred to above in the issue of August 16 is the first installment.

Explaining the Fuel Regulations

The fundamentals of the national program of fuel conservation in power plants are (*a*) personal inspection of every power plant; (*b*) rating and classification of every plant, in classes, depending on the thoroughness with which the owner conforms to the recommendations of the Fuel Administration; (*c*) at the discretion of the Administration the supply of coal to any needlessly wasteful plant may be stopped.

For the carrying out of the second stage of this program, the Fuel Administration, through its advisory engineer, Mr. David Moffat Myers, Mem.Am.Soc.M.E., has prepared standard recommendations regarding measuring and recording fuel, heating feedwater, regulating air supply, cleaning heating surfaces, maintaining and insulating settings, supervision of boiler and engine plants and of plants in buildings and shops.

As explained by Mr. Myers, this part of the work represents only one side of the fuel-conservation work, but it is the side which most concerns engineers and upon which the Fuel Administration looks to the engineer for coöperation. Mr. Myers has consented to appear before the members of the Society at the Indianapolis joint section meeting on October 25 and 26 and tell those present just what the Fuel Administration expects of the engineer. At this same meeting, too, Dr. P. B. Noyes, Department of Publicity and Education, will give an explanation of the regulations of the Fuel Administration. Full particulars appear elsewhere in this issue.

Standard Symbols in Mechanics

A great deal of work has been done by the Society for the Promotion of Engineering Education in attempting to secure uniformity of practice in the use of uniform symbols and abbreviations used in technical literature. Prof. John T. Faig, Mem.Am.Soc.M.E., has taken an active interest in this useful work and has furnished for publication the following symbols for formulae in mechanics which were approved by the S. P. E. E. on June 28, 1918.

Concept.	Symbol.
Acceleration, angular	α (Alpha)
Acceleration due to gravity	g
Acceleration, linear	a
Area	A
Breadth	b
Center of rotation	O
Coefficient of friction	f
Coefficients and constants	C, K
Deflection of beam	y
Depth	d
Diameter	D
Distance passed over	s
Distance of extreme fiber from neutral axis	c
Eccentricity of application of load	e
Efficiency (hydraulic, mechanical, volumetric)	e_h, e_m, e_v
Force	F
Force, moment of	M
Friction, coefficient of	f
Head	H
Height	h
Horsepower	$hp.$
Hydraulic radius	R_h
Inertia, polar moment of	J
Inertia, rectangular moment of	I
Length	L
Load, eccentricity of application of	e
Mass	m
Modulus of section	Z
Modulus of elasticity, Young's	E
Moment of force	M
Moment of inertia, polar	J
Moment of inertia, rectangular	I
Quantity of liquid flowing	Q
Radius	r
Radius of gyration	k
Reactions	R
Revolutions per unit of time	N
Stress, unit	S
Time	t
Torque	T
Velocity, angular	ω (Omega)
Velocity, linear	v
Volume	V
Weight	W
Young's modulus of elasticity	E

U. S Munition Output

Official report of newspaper interview with the Acting Secretary of War (condensed):

I will give you the facts about the big gun plant we are constructing at Neville Island. We signed a contract with the United States Steel Corporation to build and operate without profit this plant for guns of the larger calibers. This is the biggest plant of this kind ever conceived. The site is just below Pittsburgh and covers about 1000 acres. The housing will be on the hills south of the Island. The amount of money involved is $150,000,000. This plant will handle a tremendous amount of material.

Q. Will this plant be available for other uses after the war?

A. The plant will always be able to make steel and heavy forgings. A great deal of the machinery is special for large-gun manufacture.

Q. Will the plant be available for naval guns after the war?

A. The Government will retain it after the war.

Q. How large will the guns be from the Neville plant?

A. A 14-inch will be the minimum.

Q. Can you tell about the maximum?

A. No.

Q What plants besides the Bethlehem are now building big ordnance?

A. About 12 finishing and 12 forging plants. This number includes Bethlehem.

Q. Did you say we had shipped two hundred and fifty 155-mm. guns?

A. Yes, to France.

In reply to further questions Mr. Crowell stated: We are producing between 25,000 and 30,000 machine guns per month. Of the Browning heavy we are producing 6000 to 7000, and the Browning light automatic rifle from 8000 to 9000 per month.

Tractors: We are getting production, but it is not nearly what it should be. We are making about 1200 per month.

Rifles: The production has been steady, about 200,000 per month.

Pistols and Revolvers: We produce between 50,000 and 60,000 per month. We are expediting this.—(*Official Bulletin*, Sept. 4, 1918, pp. 1 and 6).

Meetings of Other Societies

Smoke Prevention Association

About fifty delegates, including municipal smoke inspectors, fuel supervisors and inspectors, and others, were present at the thirteenth annual convention of the Smoke Prevention Association held at Newark, N. J., August 20-22.

Several addresses were made on topics of general engineering interest. Newell W. Roberts, Vice President, International Coal Products Corporation, explained that "carbocoal" (mentioned elsewhere in this number), consists primarily of fixed carbon and contains only $1\frac{1}{2}$ to 4 per cent of volatile matter. In combustion the fuel is smokeless, igniting with comparative ease and burning freely and completely under all ordinary draft conditions. The fuel, shaped by a briquet machine to insure a maximum density, is uniform in size and quality, dustless and clean. In structure it is hard and tough, permitting ordinary handling and transportation for long distances without disintegration. In color it has a resemblance to coke, being grayish black and with a density closely similar to that of anthracite coal.

Frank W. Casler, General Superintendent of Production, Public Service Corporation of New Jersey, in a paper termed Experience in Burning a Million Tons of Coal a Year, and How We Supervise It, said that the method of procuring a coal supply today has changed very materially from what it was in pre-war times. Then the contracts called for coal to be delivered to hand-fired plants where the smoke abatement was an important factor of not more than 17 or 18 per cent volatile matter; but now the average volatile matter ranges from 23 to 25 per cent. In purchasing coal the Corporation specifies that the average ash for any one month shall not exceed a certain percentage; sufficient leeway is allowed for reasonable variation, and should it exceed this amount penalties are applied, but no premiums are paid if the average falls below what is specified in the contract, the object being to maintain a fuel supply of uniform quality.

H. D. Savage, Vice President, Locomotive Pulverized Fuel Co., referred to results attained with pulverized fuel on the Atchison, Topeka & Santa Fe R. R., the Hudson & Delaware Co. and the Central Railway of Brazil. As regards its use in stationary plants, he pointed out the possibilities for the commercial employment of such fuels as Rhode Island graphite anthracite, lignite coal of the South and Northwest, and the anthracite culm and slush, in Pennsylvania. A series of tests made in June, 1918, with an Edge Moor boiler, using Illinois and Indiana screenings, showed an efficiency of boiler and furnace of 83.33 per cent, during a 12-hour period. The increase in efficiency over using the same grade and quality of fuel on grates or in retorts was 15 per cent, with a value of fuel saving during the period of run, at \$5 per ton, of \$0.80. The one difficulty manifest in the use of pulverized coal is that it cannot be stored for long periods without danger of spontaneous combustion.

W. S. Bartholomew, Locomotive Stoker Co., presented a résumé of Mechanical Stoking of Locomotives as Related to Smoke Prevention Problems. Up to the present time 4500 mechanical stokers are in service on the railroads distributed over locomotives with from 50,000 lb. to 100,000 lb. tractive effort. The United States Railroad Administration has ordered mechanical stokers for application to all locomotives now in course of construction with a tractive effort of 50,000 lb. or over, and mechanical coal passers for smaller locomotives to be built.

Other papers were, Boiler Room Efficiency, by A. H. Blackburn; Smokeless Combustion with Chain Grate Stokers, by Thomas A. Marsh, and Bituminous Coal for Heating Boilers, by William A. Pittsford. (From the report of the Convention given in *Power*, September 10, 1918.)

Association of Iron and Steel Electrical Engineers

The twelfth annual convention of the Association of Iron and Steel Electrical Engineers was a well-attended meeting, held at Baltimore, Md., September 11-14. Besides several technical papers, two important committee reports were discussed on Rules for Safe Operation of Electric Cranes; and Methods of Education for Electrical Employees.

The first report outlines explicitly the duty and authority of each employee in matters of safety and calls attention to the reasonable requirement of the law that employees should be instructed in the hazards of their work, and to the fact that this requirement cannot be complied with more effectively than by supplying each employee with a printed copy of such instructions, which without abrogating the obligation of those in authority to give verbal instructions, will preclude the possibility of denying that full instructions have been given.

The second report is based on suggestions offered by various manufacturers and from a consideration of these the committee proposes the following two-years' course to be given by the electrical departments of steel plants:

First Year: Shop mathematics, magnetism, line and resistance calculations, diagrams and blueprint reading, d.c. machinery, motors and generators, a.c. machinery, motors and generators, inside wiring, conduit work, automatic control, and methods of braking.

Second year: Power-station layouts, switchboards and wir-

ing of same; and laboratory work comprising a conduit job complete, meter repairing and testing, motor testing and connecting, automatic control boards, curve-drawing instruments, illumination tests and calculations, meter transformers and connections, and armature winding.

A paper by D. D. Pendleton presented some considerations on Condensers and Condenser Engineering Practice, in which was a very good summary of well-known principles applying to the selection of condenser equipment and its installation and use.

A great deal of discussion was brought out by a paper on Automatic Engine Stops by Walter Greenwood. He held that automatic stops could well be extended to blast-furnace engines and to other types in mill work where they would prevent wrecks.

H. H. McLain discussed Bridge Motors for Overhead Cranes. An abstract of his paper is given in this number.

Denver Meeting of the American Institute of Mining Engineers

The 117th meeting of the American Institute of Mining Engineers was held at Denver and Colorado Springs, September 1 to 6. During the meeting many trips were made to points of interest including the electric ferromanganese furnaces of the Iron Mountain Alloy Company at Utah Junction, which it is said are being used experimentally for war purposes preparatory to larger developments; to the mining interests at Cripple Creek and Pueblo and to the works of the Colorado Fuel and Iron Company at Minnequa. This latter plant has enormous by-product coke-oven capacity and Bessemer and open-hearth furnaces and is heavily engaged upon war work. Some 6000 men are employed and the maximum monthly production of steel has reached 55,000 tons.

The papers presented at the several sessions for the most part were in the field of metallurgy and highly technical. The following titles are of greatest interest to the mechanical engineer: The Manufacture of Ferro Alloys in the Electric Furnace, R. M. Keeney (reviewed in this number); The Metallography of Tungsten, Zay Jeffries; The By-Product Coke Oven and Its Products, Wm. H. Blauvelt; The Use of Coal in Pulverized Form, H. R. Collins; Carbocoal, C. T. Malcolmson; Price Fixing of Bituminous Coal by the U. S. Fuel Administration, Cyrus Garnsey, R. V. Norris and J. H. Allport; Radium, R. B. Moore; Engineering Problems Encountered During Recent Mine Fire at Utah-Apex Mine, Bingham Canyon, Utah, V. S. Rood and J. A. Norden; Gaging and Storage of Oil in the Mid-Continent Field, O. U. Bradley.

During the convention a memorial service was held for the late Dr. James Douglas, former president of the Institute, an account of whose life appeared in The Journal for August 1918. In opening the meeting, President Sidney J. Jennings said that Dr. Douglas was an engineer, a scientist, a litterateur with a charming sense of style, a benefactor with a singularly wide variety of interests, and a man who had acquired wisdom and understanding, which surpass very great riches. E. P. Matthewson spoke of Dr. Douglas' Canadian associations and of his benevolence toward educational institutions of Canada; McGill University was highly favored by Dr. Douglas, and Queens University, from which latter he graduated. Altogether, the sums given by him to Canadian institutions would be probably up in the millions, but he was so retiring in his disposition that he seldom allowed his name to be used in connection with these matters. He also referred to the broadmindedness of Dr. Douglas in introducing the open door into metallurgy, by allowing every one to come to the plant and visit the mines with which he was connected, contrary to the usual policy of metallurgists.

W. R. Ingalls told of the well-merited business and financial success of Dr. Douglas, a remarkable feature of which was that he did not fully attain to these until nearly 50 years of age. Although he lived to the age of 81, his great accomplishments were achieved during the late years of his life. Although a captain of industry, his habits were simple and his mind was absorbed mainly in those studies most directly affecting the welfare of humanity.

A memorial service was also held in honor of the 15 members of the Institute known to have made the supreme sacrifice in the war. A service flag of the Institute showing 845 in service hung from the stage and as Secretary Stoughton read the records of those who had died in service, their pictures were thrown upon the screen.

Besides the professional sessions, the program included many interesting features, on the list of which was a banquet at Colorado Springs with the State Food Administrator as toastmaster. Among the speakers was Capt. Louis Benett, representative of André Tardieu, French High Commissioner to the United States, who won his audience by stating that the present need is not for transportation or food but "to put as many tons of steel as you have on the heads of your enemy."

At other times motion pictures were also shown, one being a Canadian film showing the adaptation to industry of soldiers crippled or disabled in the war, and another, a series of pictures showing mining and milling methods and welfare work by the Inspiration Consolidated Copper Company at Inspiration, Ariz.

Other Societies

At an enthusiastic meeting of the American Society of Marine Draftsmen, held in Philadelphia, June 29, Joseph A. Steinmetz, Mem.Am.Soc.M.E., S.A.E., Member National Research Council, Engineering Division, Member Submarine Defense Association, generously offered a cash prize of \$50 to the member of the American Society of Marine Draftsmen who contributed the most original and practical paper on The Defense of Vessels Against Submarine Attack. In this connection it is interesting to note that at the December 11, 1917, meeting of the Philadelphia Section of this Society, Mr. Steinmetz presented a paper on Offensive Against the Submarine, with annotations to the suggestions to inventors made by the Naval Consulting Board of the United States regarding the submarine and kindred problems. This paper appeared in abstract in The Journal of March 1918.

At a "Win-the-War" convention of the New England Water Works Association, held at Boston, Mass., September 11, Mr. Charles T. Main, President Am.Soc.M.E., presented a paper on the fuel situation in New England, in which he said that water-works plants using fuel or purchased power might well form a Fuel and Power Committee similar to those established in manufacturing plants. Another speaker estimated that in a total of 155 cities canvassed a saving of one per cent of water through reduction of leakage or otherwise would mean an annual saving of 5200 tons of coal.

REVIEW OF ENGINEERING PERIODICALS

For Articles on Subjects Relating to the War, see Aeronautics, Engineering Materials, Machine Tools, Munitions, Varia

Air Machinery (See also Lubrication)

Test of Tire Pumps. A test has been made at the testing laboratory of the Automobile Club of America in New York of the Cassco power tire pump, mainly for the purpose of determining the time required for inflating different sizes of tires to certain definite pressures and also the power required for operating the pump.

The pump has a single cylinder, the cylinder and crankcase being of cast iron in two parts with a fiber gasket placed between them. It has a 2.5-in. bore and a 15/16-in. stroke.

The article gives the data expressed in the form of curves. The figures for the horsepower determinations are not claimed to be correct, as the power consumed was very small in comparison with the size of the dynamometer. (*Automotive Industries*, vol. 39, no. 6, August 8, 1918, p. 243, 1 fig., *e*)

Engineering Materials (See also Hoisting and Conveying)

The Metallography and Heat Treatment of Metals Used in Aeroplane Construction, F. Grotts. The second installment of a very interesting article, a complete abstract of which will be given in an early issue. In the present issue special attention is called to the part dealing with the analysis of crankshaft material. Crankshafts made of chrome-nickel steel often contain hair lines or inclusions of manganese sulphide and silicate. They are objectionable due to the fact that they form surface cracks that will have a destroying effect on soft-metal bearings and also form slight lines of weakness. A number of such shafts were investigated with the following results.

Some shafts have stood up very well after a 100-hour run, while others show that cracks have begun to grow from the inclusions and still others have failed entirely, the failure being traced to the inclusions. As these inclusions can be avoided, and since they are unquestionably lines of weakness and do cause failures, why argue over their acceptance?

Hair lines are sometimes traced from quenching in cold water. Sometimes they are started by improper forging (forging strain). Heat treatment when not conducted properly will give a bad shaft. Variance of temperature in the furnace and crude quenching methods are the principal factors. Some pyrometers are found to be incorrect as much as 200 to 300 deg. fahr. Too much attention cannot be paid to the proper treatment of crankshafts. The gas pockets shown may be secondary pipes and the cracks connecting the pockets may be pipe cracks (expansion and contraction). A pipe generally can be removed by properly discarding the top section of the ingot, by bottom pouring, or by the use of molds having a greater top diameter than bottom. In the case of green steel there are local gas pockets.

Snowflakes occur in this steel because of poor mill practice. The manufacturer in trying to rush the heat sometimes pours while green. Furthermore, if a high-nickel bar of this steel be forged at too low a temperature there might be a condition such as this. The author prefers to think that the fault herein shown traces its origin to poor mill practice. (*Chemical and Metallurgical Engineering*, vol. 19, no. 4, August 15, 1918, pp. 191-197, illustrated, *eA*)

The Manufacture of Ferro Alloys in the Electric Furnaces, Robt. M. Keeney. A very extensive paper not suitable for abstracting. It covers in considerable detail the methods of operation in several plants producing ferrochromium, ferromanganese, ferromolybdenum, ferrotungsten, ferrovanadium and ferrouranium. The most interesting part of the paper for mechanical engineers is that referring to ferrouranium, a material about which there is still a certain amount of uncertainty.

It is stated that ferrouranium was developed not because of any particular need for uranium in steel manufacture, but because of the large quantity of sodium uranate that was accumulating as a by-product of radium production. Considerable difficulties were encountered due to the tendency of uranium to form carbides, and also because of the strong affinity of uranium for oxygen, which makes uranium oxides quite stable.

A considerable amount of experimentation has shown that it is apparently impossible to produce a ferrouranium containing 30 per cent uranium with less than 3 per cent carbon. Therefore experiments were made on producing as high a uranium alloy as possible by using uranium metal. However, a new difficulty was encountered here, that of producing uranium metal. Among other things, these experiments showed the ease with which metallic uranium oxidizes.

A method to develop uranium metal was finally developed by using uranium oxide and petroleum coke. The uranium metal made in this way contained 93.0 per cent uranium, carbon 4.39, silica 1.43, iron 1.35, vanadium 1.31, phosphorus 0.051, sulphur 0.013.

Tests were also made on addition of uranium metal to steel in a tilting Siemens furnace lined with magnesite. It was found that uranium metal is not a satisfactory agent for the addition of uranium to steel for these reasons: First, it has such a high melting point that if it is added to the steel in the furnace just before pouring in the ladle all of the metal is not melted and only a comparatively small proportion enters the steel; in the second place, when it is left in the steel bath for a period long enough to melt it, it passes into the slag and oxidizes so easily that no uranium is recovered in the steel.

Experiments were also made on the production of uranium steel and by the addition of ferrouranium to molten steel. The results were not conclusive. (*Bulletin of the American Institute of Mining Engineers*, no. 140, August 1918, pp. 1321-1373, *eA*)

Foundry

EXCEPTIONAL GANG CORE BOXES, J. V. Hunter. A gang core box used to be one which produced a few identical cores at each operation. Recently a further advance has been made, and now instead of producing a single row or two of cores to lay out on the baking plate at one time, production has been increased to making a whole plateful of cores each time that the gang box is filled. This method makes the labor involved simply one of carrying to and moving from the ovens large numbers of plates of cores.

The article shows such core boxes and the manner of making them and describes in detail the operations.

It was a comparatively simple thing to develop the gang-type core box for simple cores, but the application of this method to the production of cylindrical and other shapes, such as are usually made in halves, proved to be a much more difficult proposition. To make a gang box for either half separately would be a simple matter, but to make them so that the edges would match exactly at all points when the plates were closed caused considerable trouble.

The writer describes in detail how this problem has been solved, with the result that now a few simple operations performed with great rapidity by an experienced workman produce at each cycle a full plate of cores, which by former methods would have been made up singly in halves, baked in two separate units, then laboriously pasted together and the edges dressed up. The article is of undoubted interest in furnishing considerable information on one of the recent developments in American foundry practice. (*American Machinist*, vol. 49, no. 9, August 29, 1918, pp. 377-380, 10 figs., *dA*)

THE FLUIDITY OF MOLTEN CAST IRON, Matthew Riddell. The title chosen for this paper is claimed to be one which is meant to cover the expression of a view of the functions and operations of the cupola, which, in the author's opinion, has not been publicly discussed before.

The fluidity of cast iron is stated to depend on the amount of superheat or number of degrees of temperature over and above its freezing temperature that has been imparted to it in the cupola. The greater the superheat the greater will be the fluidity, and, other things being equal, the longer will it remain fluid to fill up the intricacies of the mold.

When the metal runs dull from the cupola various reasons are suggested, among them being lack of sufficient supply of coke. Up to a certain extent additions of coke will help, but repeated experience shows that after a certain limit of coke has been reached in the large, further additions appear to make the metal duller instead of more fluid. Another peculiarity of cupola operation is to which the writer calls attention is that better results are obtained in the way of hot metal when the bed coke is not well lighted above the tuyeres before the blast is put on and the first iron takes longer to come down than when opposite conditions prevail.

The writer bases his theory on the following:

First, that an iron which is very low in combined carbon, although high in total carbon, cannot be melted until a very high temperature is reached and consequently the liquid metal will be extremely hot. Further, in the course of melting the free graphite is rapidly dissolved and enters into solution of the iron with the result that the molten mass has a high percentage of combined carbon and, therefore, a low freezing point. Under such conditions an iron which will not melt until it has been heated to, say, 1400 deg. cent., does not freeze again until the temperature has fallen to about 1130 deg., so that such a metal may be said to have 270 deg. of life and will appear fluid.

The temperature which will be attained in the process of melting is determined by the amount of carbon in solution at the time the metal enters the melting zone and not that of the original iron charged into the cupola. Hence, in order to obtain the hottest melted metal it is essential to get the unmelted iron into the melting zone as quickly as possible. When the metal is held above the melting zone through excessive coke in the charges, the iron is afforded an opportunity to dissolve the graphite with the result that the material enters the zone with a lower melting temperature than it otherwise would have had. On the other hand, if the first charge is resting on coke which is not yet alight when the blast is turned on, its combined carbon is unchanged and the quick combustion of the coke by the blast raises the maximum temperature in the cupola before the absorption of graphite has been able to proceed very far.

In his conclusions the writer emphasizes the fact that the cupola is not suited to directly impart superheat or fluidity to any material which is being melted therein. He claims that while the freezing temperature of foundry iron may for all practical purposes be taken as constant, namely, at about 1130 deg. cent., the melting temperature varies and is regulated by the amount of carbon in combination or solution when the material enters the melting zone. (Paper before the British Foundrymen's Association meeting at Sheffield, June 1918, abstracted through *Foundry Trade Journal*, vol. 20, no. 199, July 1918, pp. 364-366, 1 fig., *g*)

ACCURACY IN SETTING CORES, J. V. Hunter. In a great majority of cases cores in molds are supported entirely by the sand. Sometimes, however, they require greater accuracy in the setting than can be obtained by supporting the cores in sand.

Thus, in the present article is described the manufacture of cast-iron tanks used under about 30 lb. steam pressure on car-heating systems. Trouble was experienced from leakage about the chaplets required to hold the core in position. The chaplets were of the long-spike type, quite heavy and extending through the top of the core to a special blocking arrangement on top of the mold, and the metal would not burn into these chaplets.

To cope with this and other troubles it was decided to support the core directly from the walls of the flask by means of a pipe extending through the core, this pipe serving for the removal of gas. The article describes in detail how this was done.

A somewhat similar problem had to be solved by a concern manufacturing small steam engines used for driving winches

and cable hoists. The quantity of identical units was large, and the boring out of the piston head and getting the rod in place required a large amount of time. For this reason it was decided to cast the rod into the head, thereby not only saving time, but also insuring a head that would not work loose on the rod.

Further, to have the head in perfect balance without finishing all over, it was necessary to set the rod in such a manner that there should be no opportunity for it to shift.

A core had previously been used to inclose a portion of the casting which was provided with the hole *A*, Fig. 1, the exact

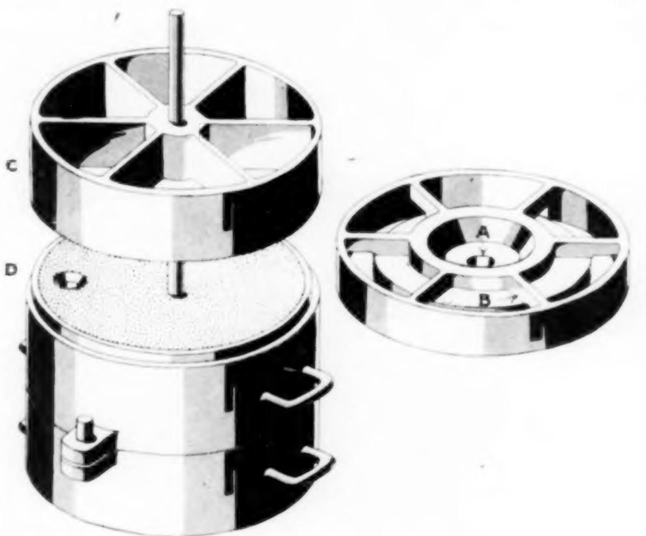


Fig. 1 Casting-in a Rod in Small Steam-Engine Piston

size of the rod, and the iron setting frame *B* made to guide the core into position in the mold.

The mold was made in a manner similar to that for the tank, being provided with a match board for the pattern that held the latter in a certain position in relation to a finished rim of the flask. The core is set by using the frame *B* to guide it into the same position relative to the finished edge of the flask as that occupied by the pattern.

The piston rod is inserted in the core, and the cope rammed about it and around the core which covers the pattern cavity below. During the ramming, and later, during the pouring of the casting, the piston rod is accurately held in a vertical position by the frame *C*, which is bored out on its lower rim to fit over the finished rim *D* on the upper edge of the cope flask. The center is bored to a close fit on the piston rod. The amount of preparation necessary to carry through this piston-head casting operation was inconsiderable and the results obtained were remarkably accurate. (*American Machinist*, vol. 49, no. 10, September 5, 1918, pp. 439-440, 3 figs., *dp*)

Fuel and Firing

Boiler Furnaces and Boiler Furnace Design, Dr. D. S. Jacobus, Mem.Am.Soc.M.E. A careful analysis of the factors affecting the efficiency of boiler furnaces, particularly with regard to those operated under steady load conditions.

The following fundamental elements in design were brought out: In the first place, enough draft must be provided to draw the products of combustion through the furnace and provide a draft suction under all conditions within the setting. Some suction should exist within all points of the setting irrespective of how hard the boiler must be driven. The next thing is to avoid a construction in which the brickwork is heated on both sides when under too great a stress (which particularly applies to the arch). Torchlike action of the flames on the walls should also be guarded against. This latter produces erosion and is apparently occurring more often with some classes of fuel than with others.

The above requirements, if satisfied, will give a furnace that will stand up. The next thing is to make it economical and this means one that will operate economically not on a short run, but under steady load conditions for long periods.

To make the furnace economical one must watch out first for excess air and then for carbon monoxide, and in this latter connection the author points out that the amount of carbon monoxide is frequently determined erroneously.

Under certain conditions it may be necessary to admit air above the fire. Hence the furnace should have such a volume and such a shape as to cause the combustible gases to mingle with the excess air.

In general, in a well-designed furnace there must be a way provided for unburned gases which come from one part of the fire to mingle with the excess air from another part of the fire.

Another feature in furnace economy is the burning out of the ash. Here care should be used since on one hand any loss of carbon in the ash counts against efficiency, but, on the other hand, one must guard against the endeavor to burn out the ash too clean at the expense of having too much excess air.

The questions of powdered-coal burning and oil fuel were also briefly touched upon by the author. (Paper before the American Boiler Manufacturers' Association, June 17, 1918, abstracted through *Power*, vol. 48, no. 9, August 27, 1918, pp. 318-320, *gp*)

Air Screens for Ovens and Furnaces, F. Wellman. Workers are greatly inconvenienced by the heat radiated from ovens and furnaces, which results in the necessity of changing the working shifts frequently and induces the workmen to refrain from examining the glowing material more than is absolutely necessary. The ill effects are somewhat mitigated by the use of hollow furnace doors cooled with cold water, but this means is only of any use when the furnaces are closed, and does not afford any protection when the doors are open for inserting or removing parts. Another method that gives partial relief consists in drawing off the hot air in front of the furnace opening by centrifugal exhausters. This method is open to the drawback that when a workman approaches the oven closely the transition of temperature is all the more sudden, and on this account more dangerous to his health. The best method to use consists in installing immediately behind the furnace door, and between the door and the furnace, a narrow slit through which cold air is blown upwards, so as to interpose a screen of air between the furnace and the door. This arrangement is found to give very good protection, and has the further advantage that flames are prevented from being forced out of the doors when they are opened, so that the workmen may operate without the use of very long tongs. The cool air has the further good effect of generally ventilating the shop in which the furnaces are placed.

Drawings and photographs of this arrangement are given, and it is explained that it is of importance that the air should emerge from all parts of the slit with the same velocity. An air-screening arrangement, manufactured by Wener Geub, Cologne, for a large steel foundry is described in some detail. The slit is only 6 mm. wide, and the air is forced out at a great velocity. Measurements showed that the velocity of the air was about 15 m. a second at 500 mm. distance from the open-

ings of the slit, and 7.9 m. a second at 1000 mm. distance. Further measurements showed that the velocity all along the slit was nearly constant. The air is driven by a high-pressure ventilator drawing from the open air. This ventilator is capable of drawing 64 cu. m. of air per minute, and is driven by a 12-hp. motor which delivers the air at a pressure of 465 mm. (water column). Further installations of a similar nature are described, and it is concluded that this type of protection should be extensively used. (*Zeitschrift des Vereines deutscher Ingenieure,* abstracted in *Page's Engineering Weekly,* vol. 33, no. 727, August 16, 1918, p. 79, *d*)

Tars Distilled from Bituminous Coal in Hand-Fired Furnaces, S. H. Katz. A paper recording results of tests made as a part of the comprehensive investigation of combustion in furnaces that is being conducted by the Bureau of Mines. It deals especially with the liquid or tar part, at ordinary temperatures, of the volatile matter evolved in a coal fire.

Three samples of such tar were examined and the results show that in the hottest fires the volatile matter evolved by the coal is the same as the so-called " primary volatile products of coal." This matter, after it is produced, yields oxides of carbon and water vapor by burning, and by cracking forms end products, i.e., carbon or soot and fixed gases. The two processes should be considered as acting at the same time and coördinately. The paper describes in detail the equipment used and the method of carrying out the tests. The results are presented in the form of tables.

It appears that the greatest proportion of tar vapors exists at the surface of the burning coal, while in the plane 1 ft. above the bed practically no tar remains, no matter what the excess of air mixed with the combustible gases above the bed.

On the basis of experimental evidence the investigator came to the conclusion that tars can exist in the fires of a hot furnace burning bituminous coal for a period that is less than 0.1 sec. The following conclusions are also of interest:

When bituminous coal in quantities to last for a period of hours is added to a slowly burning fire, tar may be found in the gases within the fuel bed through a considerable part of the time the coal is burning. When coal is added to fires in uniform quantities and at short, regular intervals, the greatest quantity of tar in the gases is at the surface of the bed.

Naphthalene and anthracene, which, at intermediate temperatures, are characteristic of the thermal decomposition of the primary volatile matter of coal, were absent from the tars collected.

It is probable that, at the high temperatures of flames, the tars that escape burning are decomposed directly to soot and fixed gases; that is, without formation of hydrocarbons such as naphthalene and anthracene, which are produced as intermediates, at least in part, at lower temperatures.

Decomposition of all the unburned tars in hot fires to soot and fixed gases occurs in less than 0.1 sec. (*U. S. Bureau of Mines Technical Paper* 195, March 1918, 17 pp. 3 figs., *eA*)

Furnaces

Graf Gas-Consuming Furnace, John Nelson. The aim in the design of this furnace was to secure the combustion of the gases which ordinarily are wasted in the operation of power boilers and pass off in the form of smoke. It has been in practical operation on a battery of Stewart boilers developing upward of 1700 hp. The plant records are said to indicate reduced fuel consumption of about 25 per cent, using bituminous coal.

The operation of the furnace is based on the introduction at the top of the bridge wall of the furnace of preheated air impelled at high velocity by a steam jet. This results in a complete intermixture of air and flue gases at a point of highest temperature, the result being a series of reactions in which escaping carbon monoxide and free carbon, together with the hydrocarbons are converted into carbon dioxide.

The ordinary bridge-wall form is discarded, and instead of a straight horizontal top, the wall is curved as an inverted arch, the arc corresponding to that of the boiler shell. It is claimed that a more uniform flow of gases from the firebox along the circumference is obtained. The air is introduced into the furnace through a 4-in. pipe which is brought down

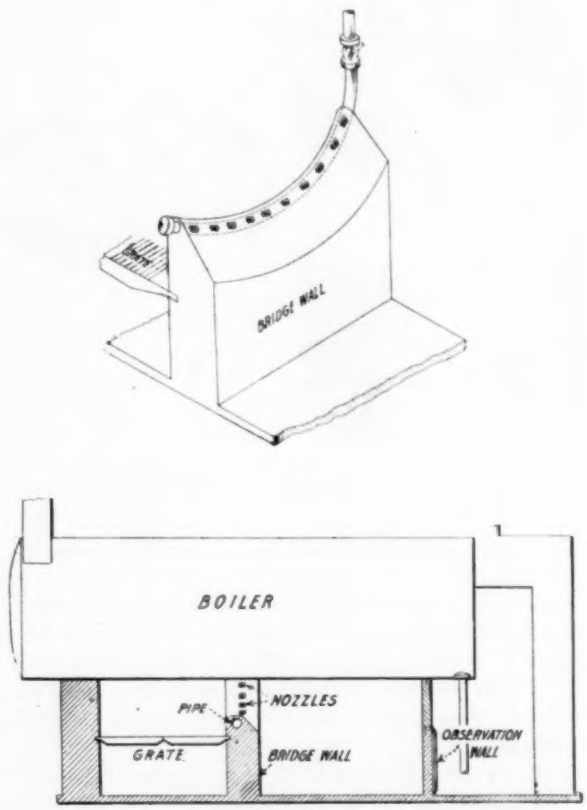


Fig. 2 Some Details of the Graf Furnace

through the masonry of the side wall and is curved to conform with the arch of the bridge wall in which it is imbedded. The actual entrance of the air into the chamber is through a series of nozzles (Fig. 2). As shown in the figure, the lower interior wall of the nozzle is given an even, gentle curve, which serves to facilitate and guide the flow of air. The nozzles are so spaced that their jets combine at a point about 6 in. above the bridge wall to form a solid stream of air covering the complete width of the furnace. The nozzles are set at an angle of 70 deg. in the direction in which the gases flow. The air is delivered by a steam jet. The steam is admitted through a nozzle $\frac{1}{16}$ in. in diameter. The vacuum is created by the steam sucking in an amount of air which is proportional to the volume of steam used. The steam serves a double purpose of preheating the air and of giving a velocity sufficient to produce a complete intermixture with the flue gases.

Tests made at the Worcester Polytechnic Institute demonstrated a complete absence of carbon monoxide in the flues, as well as a minimum of free carbon. The observation doors reveal a condition of apparently full incandescence in the

combustion chamber, even immediately after stoking. (*The Iron Age*, vol. 102, no. 6, August 8, 1918, p. 339, 1 fig., *d*)

Hoisting and Conveying

A Safe-Load Chart for Rope Slings, F. W. Salmon, Mem.Am.Soc.M.E. A chart intended to meet the requirements of practical men. A card, Fig. 3, about 3.5 by 6 in., is divided around the edge as a protractor, every 10 deg. being marked with a plain black triangle. In the center space appears a chart of the safe loads based upon the particular kinds and sizes of slings that are used in the shop. Upon the back of the card may be printed directions for its use.

When an unusual load is to be lifted, the foreman can hold the card in the manner shown in Fig. 4, and when the sling

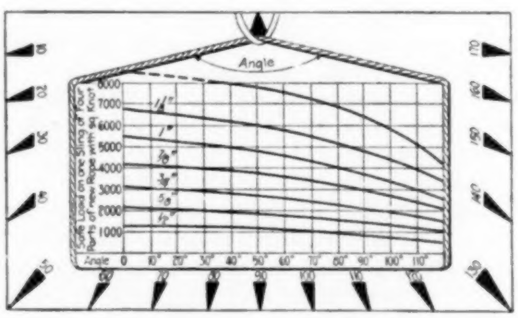


Fig. 3 Load Chart for Rope Slings

just becomes taut he can estimate the angle to about the nearest degree. Having the total weight to be lifted, he can instantly determine whether or not the sling is safe to handle the load. (*American Machinist*, vol. 49, no. 6, August 8, 1918, p. 242, 2 figs., *p*)

Bridge Motors for Overhead Traveling Cranes, R. H. McLain. Discussion of the factors affecting the selection of sizes of motor and gear ratio for bridge motion of overhead traveling cranes.

Fig. 4 Manner of Using the Chart in Fig. 3

The author analyzes the work done by the bridge motor and states that four things which tend to limit the rate of its acceleration. They are as follows:

Automatic magnetic control can absolutely limit it;
Slipping of wheels can partially limit it;
Swinging of load can limit it in some cases, and finally
It may be limited through considerations for the comfort of the operator.

An average acceleration of something like 1 to $1\frac{1}{2}$ ft. per sec. per sec. will be fast enough for cranes which travel at less than 500 ft. per min. or make infrequent starts. Cranes which make regular frequent trips of 50 to 60 ft. every minute or so may need an average acceleration of 2 to $2\frac{1}{2}$ ft. per sec. per sec. and special cranes handling heavy swinging loads may need still higher peak accelerations.

The motor is always out of danger when it is powerful enough to slip the wheels under full load without exceeding its working limits, and the practical way of protecting the motor is to have the crane do its work with only a quarter of the wheels driven, where it is possible to do so.

The swinging of the load will, in some cases, have a great deal to do with the rate of acceleration, and, for example, when the load is hung from the crane by a flexible rope, the motor is relieved somewhat, as it does not have to start the load as soon as the crane starts.

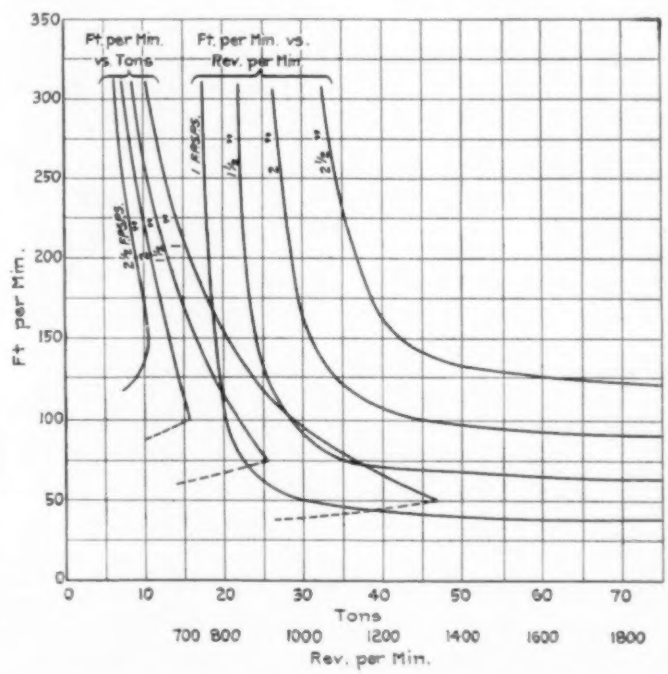


Fig. 5 Acceleration Chart for Overhead Traveling Crane Bridge Motors

The discomfort of the operator becomes an important factor where manual control is used, rough material is being handled and half of the wheels are driven. In order to get data on the subject, the author asked several manufacturers to send him test data on their cranes. These data show a variation in the peak rates of acceleration in feet per second per second from 0.54 to 3.09 for empty cranes and 0.348 to 1.85 for loaded cranes, the weights of the complete cranes in pounds being, respectively, 90,000 and 320,000.

The table covers the range of cranes with rated loads from 10 tons to 100 tons, and shows quite wide variation within the limits indicated above of the peak rates of acceleration. The author gives a formula for calculating the rate of acceleration with or without load used in compiling the table referred to above.

It is claimed that the rate of acceleration is absolutely as important as the final speed of the crane in determining the sizes of motor for a crane. In order to show what a given motor may do under various conditions of load, speed and rate of acceleration without exceeding its working limit, the author prepared Fig. 5. While calculated on several assumptions which may not be altogether correct, the curve gives a basis

for comparing conditions. These assumptions are that rolling friction of crane is 50 lb. per ton, and that there are no gear losses between the motor and the track. The maximum peak torque allowable at the motor shaft is taken at 78 lb-ft. The total flywheel effect of motor, armature, brake, wheel and gears is taken as 8.4 lb. at 1 ft. radius on armature shaft.

The way to use Fig. 5 is as follows: Suppose a 12.5-ton loaded crane is being considered and a rate of acceleration of 2 ft. per sec. per sec. is desired. Then read up from 12.5 tons to the curve marked "2 ft. per sec. per sec." The intersection is at 170 f.p.m. Then read across from 170 f.p.m. to f.p.m. vs. r.p.m. curve marked "2 ft. per sec. per sec." The intersection is at 995 r.p.m. This indicates that the motor should be geared so that 995 r.p.m. corresponds to 170 f.p.m., and that when so geared it can start 12.5 tons at 2 ft. per second per second peak acceleration without exceeding 78 lb-ft. torque on the motor shaft.

The writer recommends that if automatic magnetic control is going to be used on the crane, an acceleration should be adopted of 2 ft. per sec. per sec. for all cranes except those which have swinging loads or which make very short, rapid trips of something like 50 or 60 ft. per min. when a peak acceleration of 3 ft. per sec. per sec. should be used. If, however, only a quarter of the wheels are driven, the peak acceleration may, in all cases, remain not higher than 2 ft. per sec. per sec.

With manual control a peak acceleration of 1 to 3 ft. per sec. per sec. should be used, depending on the nature of the work. For power-house and stand-by cranes, 1 ft. per sec. per sec. is ample; for hot-metal ladle cranes 3 ft. per sec. per sec.; and for busy loading cranes 2 to 3 ft. per sec. per sec. (Paper before the Twelfth Annual Convention of the Association of Iron and Steel Electrical Engineers, Baltimore, September 1918, abstracted from an advance publication, 9 pp., 2 figs., *pg*)

Hydraulic Engineering

HYDRAULIC ACCUMULATOR PROTECTIVE VALVE. Description of a new type of valve designed to protect large accumulator systems.

The valve is installed directly at the pipe outlet of the accumulator with a pilot-line connection to some distant point of the piping system. The pressure of the liquid from the pump lifts the main check and charges the accumulator. At the same time the plunger in the cylinder is raised, thus holding the main check off its seat irrespective of whether the accumulator is being charged or discharged, as long as the pressure of the pilot line is maintained. If a break should occur in the piping system, the pressure is immediately lowered, and this loss of pressure in the pilot line and small cylinder is overcome by a spring permitting the plunger to drop.

Hence, as long as the pressure is maintained in the system the liquid flows freely, but if the pressure should be lowered for any reason the main check valve is seated, which prevents falling of the accumulator. (*The Iron Age*, vol. 102, no. 7, August 15, 1918, p. 389, 1 fig., *d*)

Internal-Combustion Engineering

THE DIESEL MOTOR INJECTION VALVE, W. Stremme. (*Zeits. Vereines Deutsch. Ing.* 62, pp. 111-115, March 9, 1918.) The influence of the injection valve on the injection performance is considered, and it is shown that the nozzle opening is the basis of standardization. Standardization is quite feasible and is essential to the bulk production of Diesel motors. Charts are given showing standardized and unstandardized values of nozzle and needle diameters, etc., for Diesel engines ranging from 25 to 200 hp. per cylinder. One important advantage of standardization would be the easier obtaining of perfect combustion without repeated trials and adjustments on individual engines. (Taken from *Science Abstracts*, Section B—Electrical Engineering, vol. 21, pt. 7, no. 247, July 31, 1918, p. 250, *g*)

INDEPENDENTLY DRIVEN CIRCULATING PUMPS FOR JACKET WATER. In the case of oil engines, particularly those of the Diesel type, the pressures in the cylinders are very great, necessitating the use of heavy cylinders and pistons. There is, therefore, a large amount of metal present and a considerable amount of heat stored therein.

When the engine is shut down after a period of full load and the water circulation simultaneously ceases, enough heat is still stored up in the metal to evaporate the hot water in the jacket and leave an excess. This excess is conducted through the walls into connected parts that were not designed to withstand temperature stresses and as a consequence they are strained or cracked.

The suggestion is made that an independently driven pump should be used instead of a direct-connected pump, so that the pump may be kept running after the engine has stopped until all the heat is removed and the metal is cooled to a normal temperature. (*Power*, vol. 48, no. 7, August 13, 1918, p. 238, *p*)

GILE SUB-PISTON ENGINE. Description of a two-stroke engine having, in addition to its regular working piston, a sub-piston in each cylinder, operated from a special crank on the crankshaft.

During the power stroke the main and sub-piston both travel in the same direction and at substantially the same rate of speed. This continues until they have reached a point where the main crank is within 45 deg. of the bottom dead center, at which point the exhaust valve begins to open. As soon as the exhaust valve opens the sub-piston is gradually stopped by a rocker-arm movement and is then started on its return stroke, during which it scavenges the cylinder of the burned gases and at the same time draws in a fresh charge of gas from the carburetor through the intake ports in the cylinder walls near the lower end of the stroke.

In the cylinder walls at the upper end there is a series of flutes which afford a passage for the gas in the space between the main piston and the sub-piston. It is claimed that the fuel in passing through these flutes is so thoroughly broken up that the engine can burn kerosene as readily as gasoline, no preheating of the fuel or air being required. (*Automotive Industries*, vol. 39, no. 6, August 8, 1918, pp. 229 and 238, 2 figs., *d*)

Lubrication

LUBRICATION OF AIR-COMPRESSOR CYLINDERS, W. H. Callan, Mem.Am.Soc.M.E. A résumé of experience with air-compressor cylinder lubrication in which it is claimed that the temperature of the inside of the cylinder wall of a water-jacketed cylinder is not more than 30 deg. fahr. higher than the temperature of the jacket water as long as the water does not boil.

In view of this condition, the writer claims that a light mineral oil should be used rather than oils of heavy grade and high flashpoint; further, that a pure mineral oil should be used, preferably one having a gravity of from 31 to 33 Baumé, a

flashpoint of 375 to 390 deg. fahr. and a viscosity of 140 to 150 Saybolt at 100 deg. fahr. (*Power,* vol. 48, no. 7, August 13, 1918, pp. 229-230, *g*)

Machine Shop

Emulsion Lubrication of Cutting Tools, J A. De Cew. Discussion of the lubrication of cutting tools with special reference to their lubrication by materials in a state of emulsion.

If oil is mixed with a substance which is soluble in a large amount of water, and subjected to mechanical action, the oil is broken up into fine particles which float in water and thus produce what is known as an emulsion.

As the emulsifying agent is usually more expensive than oil, only enough of it is used to cause the emulsion to form. It is believed that as the oil particles in suspension came in contact with the hot tool surfaces, some of them are interposed between the parts in contact and thereby produce lubricating action.

The coarser oil particles are said to be prevented by their size from penetrating between the surfaces as far as the aqueous medium, but the finer particles which are microscopic in size follow the solvent and perform lubricating service.

If the compound is slowly stirred into water very white emulsions are likely to be produced, from which a portion of the oil will gradually separate if allowed to stand for a time, but if the compound is diluted in water by means of pressure, using special apparatus and proper temperatures so that instantaneous solution can take place, then the emulsifying agent may be diluted with water without breaking up its combination with the oil, and a diluted solution is obtained which resembles the original compound in character.

When such a solution of oil dries on a metallic surface, it leaves a film which acts as a protective coating against rust. (*American Machinist,* vol. 49, no. 10, September 5, 1918, pp. 433-434, *p*)

Using a Punch Press in Lieu of Bending Rolls, J. V. Hunter. Brief description of the way in which awkward and annoying jobs involving the bending and forming of sheet metal may be rendered simple and easy by means of a few cheaply made dies of hard wood used in the ordinary form of punch press to be found in any structural shop. The article is of considerable interest in that it calls attention to the possibilities of the use of wooden dies. (*American Machinist,* vol. 49, no. 6, August 8, 1918, pp. 243-245, 6 figs., *g*)

Electric Furnace for Heat-Treating of Small Aeroplane Parts, Dwight D. Miller. The article refers to the handling of nickel-steel parts and presents the subject from the point of view favorable to the electric furnace. The method of carrying on the heat-treating operations with such furnaces is described in detail. (*American Machinist,* vol. 49, no. 9, August 29, 1918, pp. 373-376, 2 figs., *p*)

Gas-Engine Work on the Pacific Coast, Frank A. Stanley, Mem.Am.Soc.M.E. Description of machine operations used in the shops of the Atlas Imperial Engine Company, of Oakland, Cal., in building stationary, portable, marine, hoisting, etc., engines.

The company builds units of one, two, three and four cylinders, ranging in capacity up to several hundred horsepower, and has, therefore, to arrange for performing a number of operations.

Fig. 6 shows the arrangement of the crankshaft bearings and base compartments, the bearings through the automatic ring oilers receiving the lubricant from a chamber below the shaft. The main bearings are of unusually great length, about ten times the diameter of the shaft.

The lower case for the crankcase proper is formed by a finished surface along the top of the base casting. The crankcase consists of an integral rectangular frame for enclosing all the working parts of the engine with the exception of the pistons and valves. The top of the crankcase is adapted to receive the cylinders, and each side of the case is fitted with doors to give easy access to the interior.

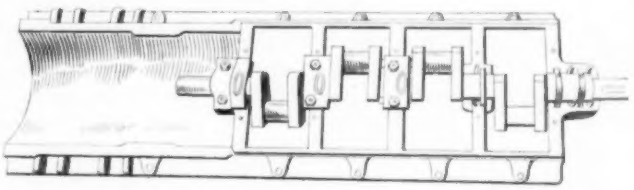


Fig. 6 Arrangement of Crankshaft Bearings and Base Compartments

The cylinders are cast with heads as an integral part.

An interesting detail is shown in Fig. 7, namely, the reversing gear for use with marine engines. In this gear there are six pinions spaced about the central gear, all made from steel forgings and provided with bronze bushings. The entire set of gears is enclosed in an oiltight casing and runs in oil all the time. This gear arrangement is of interest, as it gives the propeller the same rate of speed astern as when running ahead.

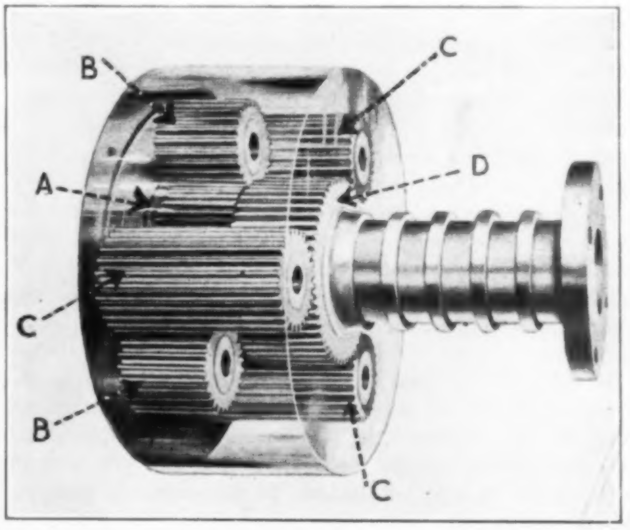


Fig. 7 Reversing Gear for the Atlas Imperial Engine Company Marine Engine

The go-ahead drive is by means of a friction clutch of the multiple-disk type, which admits of adjustment by loosening a single bolt and screwing around a clamp collar. The gear case is a plain cylindrical affair, which when the reverse lever is operated is prevented from rotating by a pair of clamp shoes, or brakes, which are actuated by a powerful screw-and-toggle motion; at the same time the friction is released.

The reverse drive is then through the gears and pinions as follows: The power from the engine is transmitted through the shaft to the spur gear *A*, which, when the case is prevented from turning by the clamps before mentioned, drives three short pinions *B* (two of which may be seen in the cut), and these drive the long pinions *C* which mesh with the gear *D* upon the propeller shaft. The reverse direction of rotation

therefore occurs between pinions *B* and *C*. (*American Machinist,* vol. 49, no. 8, August 22, 1918, pp. 343-347, 16 figs., *d*)

RECLAIMING OIL FROM METAL TURNINGS, C. L. Smith. Description of a system for collecting steel turnings, recovering the cutting oil that usually clings to them, and loading them on cars, as used in the plant of the Cincinnati Milling Machine Company.

Receiving trucks are provided for conveying the turnings to the oil and scrap building, located about 100 ft. distant from the main plant. The design of the trucks is such as to eliminate the handling of the turnings as much as possible, and actually only two of these trucks operated by one man are needed for the entire plant.

The trucks are lined with sheet metal and the sheet covering the sloping bottom is perforated at the lower end to allow the oil drained from the turnings to pass into the tank located below. A 4-in. baffle plate is provided at the front to divert the oil into the receiving tank underneath, and at the top of the perforated section an oil splash guard is placed for the same purpose. Means are provided for easily draining and cleaning the oil tank and unloading the chips into the oil separator. The top of the separator is level with the floor which is preferable to one having the top located above the floor level.

For collecting the chips a specially shaped galvanized steel pan is used. This pan is placed on a small shop truck directly beneath the sliding door in the oil pan of the screw machines and the chips can be raked into it without spilling oil on the floor, which again is claimed to be preferable to the usual method of removing the turnings from the machine oil pan with a fork and putting them in a wheelbarrow.

After being filled the collecting pans on the shop trucks are carried to the rear of the shop where the receiving truck is stationed.

By the receiving truck and the elevators the turnings are delivered to a Tolhurst oil separator.

The dry chips are ultimately dumped into specially arranged concrete switch bins, therefrom to be loaded on cars. These bins have sloping bottoms and sheet-metal doors that are the full height of the bins. The bins are about 25 ft. apart so that a standard 40-ft. car can be loaded from both ends at the same time.

Records of the company show that the oil reclaimed from the turnings represent a really worth-while saving. In April 1918 3092 gal. were recovered, in May 2400 gal. and in June 1402 gal., the general average being about 100 gal. per working day. (*The Iron Age,* vol. 102, no. 10, September 5, 1918, pp. 558-559, 2 figs., *d*)

SAND-BLASTING MACHINE, M. E. Hoag. In an article under the title Manufacturing the Comptometer, the writer, among other things, describes machines used for sand-blasting the comptometer parts.

One of such machines is shown in Fig. 8, built and designed for this special purpose. The body of the machine *A* carries a shaft and set of pulleys at each end, over which pass endless rubber belts for carrying the work under the blast nozzles. Under the machine is a hopper through which the spent sand runs by gravity to a switch bin, from which it is carried by elevators to a supply bin overhead. Sliding doors at *B* permit work to be held under the blast by hand and glass windows at *C* allow the workmen to watch the progress of the work without risk to eyes and lungs.

The sand runs from the overhead supply bin to the nozzles through the spout *D* to the gates *E,* which have screw adjustments and distribute the sand in a long, flat stream under the air nozzles *F*, and the opening in the machine body at *G* is closed by a canvas curtain and permits work being placed on the endless belts. The exhaust pipes *H* carry off the spent air and fine dust, leaving the returned sand always clean and ready for use. These machines use from 12 to 14 oz. air pressure. (*American Machinist,* vol. 49, no. 9, August 29, 1918, p. 391, 1 fig., *d*)

Machine Tools

FLUSH-PIN VERSUS LIMIT GAGES, Albert H. Dowd. Description of several types of flush-pin gages, both for work and inspection, and a general discussion of the application of such gages.

Limit gages are not always reliable when the product is such that it must be kept within very close limits of accuracy. This is due to the fact that the ordinary go and no-go gages do not determine the fluctuations in the work sizes to any appreciable degree. The writer gives an example where with a

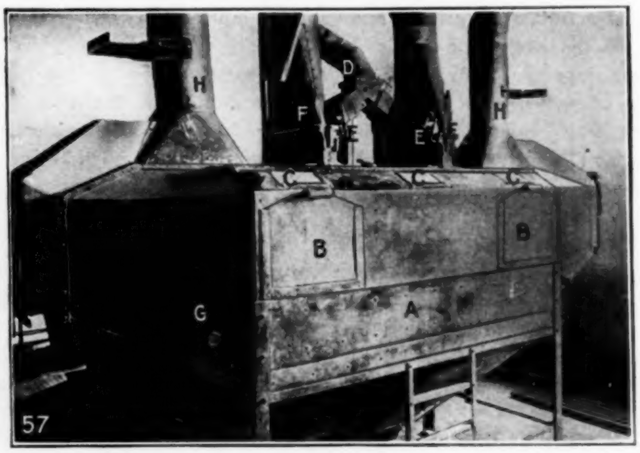


FIG. 8 SAND-BLASTING MACHINE

go gage of 1.998 and no-go 2.001, a hole machined so that it actually measured 2.0005 would still pass inspection. Yet while the work would be verging close to the danger line, the operator would not be aware of it, except by the feel of the gage as he entered it in the hole. The very next piece of work might not pass the gage due to the wear of the tools, and if the operator were inclined to be careless, three or four pieces might need reboring before the error became apparent.

In boring and turning, plug and snap limit gages are used universally, but for gaging depth, shoulder distance and work of this kind, the writer believes that another type of gage should be considered, namely, one which will act as a limit gage and at the same time show the machine operator how closely he is approaching the danger line.

The flush-pin gage is of this type. It is used to considerable extent on gun work for close tolerances and can be made up at a reasonable price. In its simplest form it can be used for tolerances of about 0.005 in. or greater, and with additional refinements it can be made to indicate a fluctuation of 0.005 in. or even less.

The application of the flush-pin principle in gaging a piece of work during machining is shown in Fig. 9. In this case the work *A* must be machined so that depth *B* will be within a tolerance of 0.25 mm. This gage is on the same principle

as flush-pin gages generally, but as the work is recessed, provision is made in the shoulder G to roughly center the tool when placing it in the work. This facilitates the handling and roughly locates the flush pin against the face of the casting C. The registration of this gage is by means of the pin E,

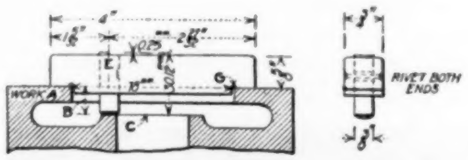


Fig. 9 Method of Using a Flush-Pin Gage

which is shouldered, as shown, to indicate the variations in the facing of the boss C.

The flush-pin principle can be applied to work requiring especially close tolerances by the addition of an indicator multiplying lever in connection with a suitably graduated scale. (*American Machinist*, vol. 49, no. 7, August 15, 1918, pp. 283-284, 5 figs., *dp*)

Metal-Concrete Planing Machine. In the June 1918 issue of The Journal (page 505) an abstract from the *American Machinist* was given describing a large planing machine with a concrete bed.

Sheet Corrugating and Curving Machines. Description of specially constructed machines for corrugating steel shelters for the United States Army.

These shelters are made of No. 11 gage sheet steel and are corrugated 4 in. deep by 12¾ in. center to center. The top and bottom of the corrugations are 5¾ in. wide each and the sides are on a 15 per cent angle. After being corrugated the sheets are curved to a 5-ft. radius on a machine, also specially designed for this purpose and described and illustrated in the original article.

The corrugating machine has semi-steel, hexagon-shaped, hollow-cored rolls, with cross-ribs running their entire length. The rolls are drilled and tapped for interchangeable dies, which are also of semi-steel, and the corrugations are machined out of the solid. The machine is 10 ft. high and weighs when assembled 85,000 lb.

The curving roll forms the sheets after they have passed through the corrugating machine. It occupies a floor space of 6½ by 12 ft. and weighs 10,000 lb. (*The Iron Age*, vol. 102, no. 9, August 29, 1918, p. 501, 2 figs., *d*)

Measuring and Testing

A Comparison of Various Manometers, L. Holborn (*Ann. d. Physik*, 54.7., pp. 503-510, April 9, 1918. From the Physikal.-Techn. Reichsanstalt). For pressures higher than those suitable for the mercury manometer, there are several instruments on the market. These, in some instances, register pressures as high as 1000 kg./cm.². One form mentioned in detail is a differential manometer. The pressure is communicated by resin oil to the inside of a strong cylinder. Here it acts on a plunger, whose ends project from the cylinder, but whose center, in the cylinder, is slightly tapered.

The author points out the corrections necessary for change in dimensions of the metal due to the pressures. Two manometers compared over a range 100 kg./cm.² to 1000 kg./cm.² differed by 0.03 per cent at low pressures, but by only 0.01 per cent above 300 kg./cm.². Another manometer, less satisfactory, showed differences from each of the above of about 0.18 per cent. (Taken from *Science Abstracts*, Section A—Physics, vol. 21, pt. 7, no. 247, July 31, 1918, p. 281, *c*)

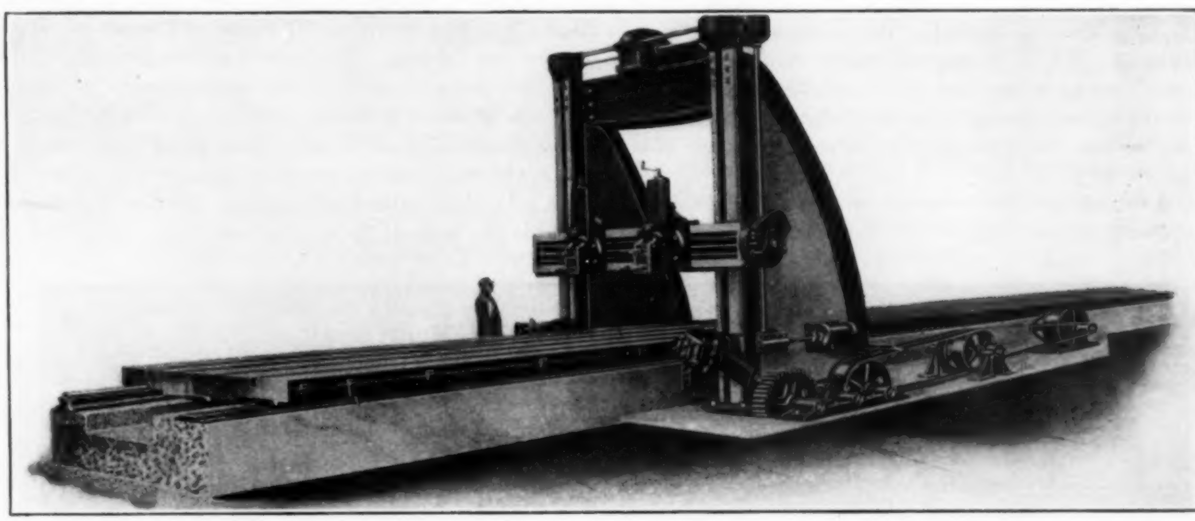


Fig. 10 Metal-Concrete Planing Machine

The present article briefly describes a similar machine developed by David A. Wright, of Chicago, and states that the machines are built in sizes ranging from 6 to 20 ft. with any length of bed. The platen of the machine is made of structural-steel sections, with inserted cast-iron T-slots (Fig. 10) in the upper surface and is filled with reinforced concrete. After the concrete filling has set and the platen is put in position on the machine, the upper surface is planed off. The ways on which the platen travels consist of a flat cast-iron one for the front and a piece of steel shafting for the rear one, both supported by concrete foundations. The frame of each side housing consists of three castings for the front, back and base, respectively. After these have been finished and assembled, concrete is poured in to provide rigidity. The feed is of the pneumatic type. (*The Iron Age*, vol. 102, no. 8, August 22, 1918, p. 449, 1 fig., *d*)

METHOD FOR TAKING MOVING PHOTOMICROGRAPHS. At the last annual meeting of the American Society of Testing Materials at Atlantic City (June 1918), considerable interest was aroused by the exhibition of moving photomicrographs by Prof. Herbert F. Moore of the University of Illinois, Urbana, Ill.

The moving photomicrographs shown represented the first successful attempt for recording the gradual changes in the structure of a metal when subjected to repeated bending stresses. The great possibilities of this method are, of course, obvious.

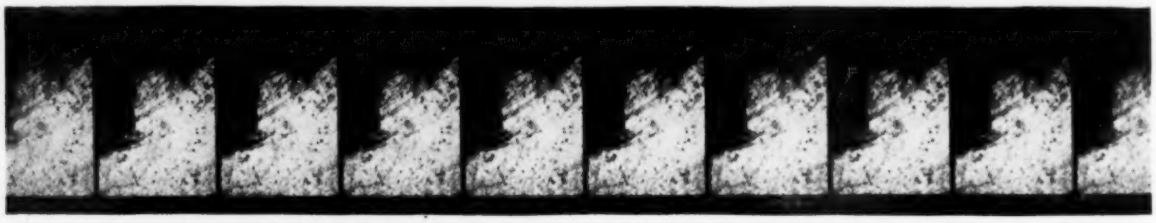


FIG. 11 STRIP OF PRINTS FROM FILM SHOWING DEVELOPMENT OF SMALL CRACKS OR SLIP LINES

The present article contains illustrations of the machine which was used to bring a wrought-iron test piece under repeated stress, as well as the apparatus used for taking the moving photomicrographs.

In Fig. 11 is shown a section of the original film early in the experiment. This is a strip of prints showing development of small cracks or slip lines with magnifications of about twenty times. These photographs were taken at the rate of sixteen per second, the exposure used being one-fiftieth of a second.

The original article also contains seven still photomicrographs showing the development of slip lines in a specimen of iron from the unstressed state to the finally developed crack. Fig. 12 is likewise of interest in reproducing a strip of prints from a film showing the various phases in the development of a large crack.

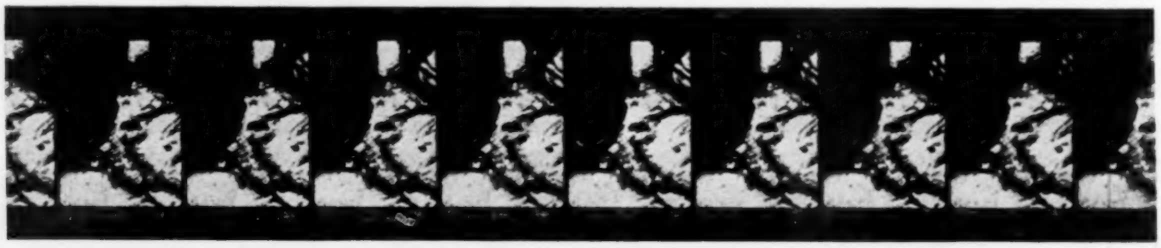


FIG. 12 STRIP OF PRINTS FROM FILM SHOWING DEVELOPMENT OF LARGE CRACKS

So far the moving-photomicrograph method has been applied only to wrought iron, because of the large crystals and distinct markings, and also because of its easy deformation under stress, but it is expected that ere long this method will be applied to steel and non-ferrous metals and alloys. It has been stated that this new device may determine just how steels begin to deteriorate under stress. In this way it may lead to new methods of heat treatment prolonging the life of certain steels and rendering them less liable to fatigue. In any event, it will give a much clearer insight than we have had hitherto into the actual growth of strain phenomena and ways they affect metal of various physical and chemical structures. (*The Iron Age*, vol. 102, no. 6, August 8, 1918, pp. 323-325, 10 figs., *d*)

Mechanics

CONCRETE BEAMS WITH FIXED ENDS. In many cases building ordinances make no provision for fixed ends of concrete beams. The design requirement for a single-span concrete beam supported on concrete columns at each end provides that the beam shall be designed for a moment of $WL/8$ at the center, which is approximately only for brick bearing walls, but is not true where the beam is supported by concrete columns more or less fixed to the beam, as little or no provision is made to allow for the bending to which the column must be subjected as a result of the rigid connection with the beam. This method of design provides a beam about 50 per cent too strong and may prove to be excessively weak in long-span construction columns. The present article gives the discussion of a fixed beam designed in reinforced concrete as applied in the construction of a factory building in Illinois.

The distribution of bending moments through the columns and beams was obtained by the method of slopes and deflections. In this method of analysis the bending moment is found in the beam at the intersection of the center lines of the column and mid-depth of the beam and in the column just above and below this intersection.

Fig. 13 shows the design used for one of the frames. In designing the columns for direct load and bending care must be taken in considering the column section just above the floor, as this is the critical point. This is due to the fact that this location is as high as anywhere in the columns, and, in addition, only the bare column section, without any bracket, is available to take up the stress.

The original article gives a complete calculation of the various moments. (*Engineering News-Record*, vol. 81, no. 8, August 22, 1918, pp. 359-361, 5 figs., *pA*)

Munitions

THE 75-MM. FIELD GUN, MODEL 1916, M. III. Special correspondence to the *American Machinist*, describing the latest

of the four types of 75-mm. field guns built by the United States Government. The article gives the length, weight and other data, and describes and illustrates the component parts of the breech-closing and firing mechanism.

The gun weighs 749 lb., has a total length of 90.9 in., and a right-hand twist constant from origin to muzzle. It can use either shrapnel or shell, the weight of the shrapnel being 15.96 lb. and the weight of the shell 12.36 lb.

A service pressure of 33,000 lb. per sq. in. is used. The mechanism is of the drop-block type and is semi-automatic, the block closing automatically when a round of ammunition is inserted.

A complete and interesting description is given of all fea-

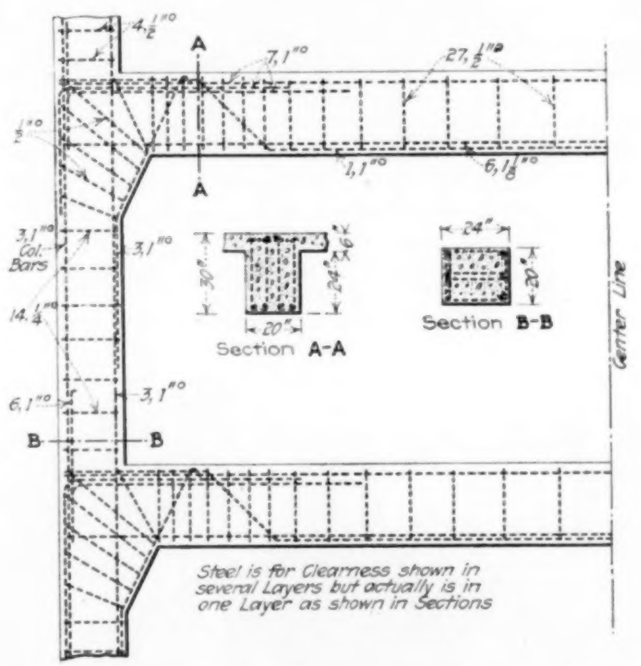


FIG. 13 REINFORCING DETAILS AT RIGID CONNECTION OF BEAM TO COLUMN

tures not involving elements of military secrecy. (*American Machinist*, vol. 49, no. 8, August 22, 1918, pp. 323-328, 4 figs. and table of nomenclature of the breech mechanism, *dA*)

Power Generation

DEVELOPMENT OF POWER FROM THE STANDPOINT OF THE BOILER ROOM, C. F. Hirshfeld, Mem.Am.Soc.M.E.. J. E. Aldred lecture on Engineering Practice at Johns Hopkins University.

The writer states that although only a small percentage of the latent heat contained in fuel is converted into electric energy there is comparatively little improvement to be hoped for in power plant economy, but there is a large and profitable field for betterment in the operating conditions of the *average* power plant. He emphasizes that in a boiler plant it is not the highest thermal efficiency but the highest possible commercial efficiency that is aimed at. He presents from this point of view an interesting study of the overall efficiency of a boiler showing how step by step the entire installation of a power plant is usually a compromise between various requirements. (Abstracted through *Power*, vol. 48, no. 8, August 20, 1918, pp. 284-286, 2 figs., *g*)

Power Plant

BOILER EQUIPMENT OF THE AUZBERG POWER STATION, P. Koch. (*Zeits. f. Dampfkessel. u. Maschinenbetrieb*, No. 43, 1917. *Elektrot. u. Maschinenbau*, 36. p. 158, March 31, 1918. Abstract.) It was made a condition that the grates should burn Bohemian brown coal economically, and it was found by trial that the Piedboeuf chain grate was most suitable for this fuel. Four Burkhardt vertical-tube boilers are used, each of 400 m.^{2} heating surface and designed for 15 atmos. working pressure with superheater and wrought-iron economizer. Induced draft is provided, and the total grate surface of each boiler is 17.2 m.^{2} Flue ashes are caught in special spirals and removed below the boiler-house floor. The wrought-iron chimney is 29.5 m. high and 1500 mm. internal diameter. Butterfly plates below the grate cut off the air supply from part of the grate area at times of light load. The accompanying table gives the principal results of three steam trials:

Test No.	I	II	III
Kg. fuel per m.^{2} of grate surface	149.7	199	222
Kg-cal. per hr. per m.^{2} grate	565,000	706,000	800,000
Draft in combustion chamber, mm. of water	2.5	2.7	5.2
Draft behind economizer, mm. of water	5.2	5.7	10.6
Percentage of Heat:	%	%	%
Utilized in boiler	62.9	59.6	59.8
Utilized in superheater	5.3	6.1	7.5
Utilized in economizer	11.8	10.5	11.9
Lost in flue gases	13.2	12.4	15.0
Lost in ash (unconsumed), radiation, and conduction	6.8	11.4	5.8

A noticeable point is the low draft required. The loss of draft amounts to 2.7, 3, and 5.4 mm. water column at heating-surface loads of 28.3, 33.3, and 38.1 kg. per m.^{2} respectively. During these tests the guaranteed maximum power was obtained without artificial draft. (Taken from *Science Abstracts*, Section B—*Electrical Engineering*, vol. 21, pt. 7, no. 247, July 31, 1918, p. 249, *d*)

Refrigeration

THE PRACTICAL SIDE OF THE LOW-TEMPERATURE COMPRESSION SYSTEM, H. Sloan. Description of three different installations put into operation during 1917. All are operated in connection with brine-cooling systems. In addition to the description of the installation itself are given data of tests and some of the temperature readings especially analyzed.

The average suction pressure for the low-pressure cylinder was 0.935 lb. while the average temperature was — 11.85 deg. fahr.

This temperature agreed very closely with the outgoing brine temperature and did not follow temperature changes due to differences in the suction pressure, which means that the degree of superheat depends upon the temperature of the brine circulated.

The discharge temperature for the low-pressure cylinder averaged 123.3 deg. fahr. The gas entering the intermediate pressure drum (a long header into which the gas from the low-pressure ammonia cylinders is discharged and where it is cooled to the saturation point of the pressure corresponding to the intermediate pressure) was cooled to the average temperature of 15.19 deg. fahr., at which temperature it entered the high-pressure cylinder. The average pressure on the intermediate drum was 28.4 lb. and the temperature of saturated gas cor-

responding to this pressure is 15.5 deg. fahr., which indicates that the gas entered the high-pressure cylinder in a saturated condition and is important as an indication of the efficiency of the method employed for removing the superheat due to compression in the low-pressure cylinder.

If the low-temperature compression system secures the desired results, it will have the advantages of smaller dimensions in the cylinders on account of higher volumetric efficiency, and a reduction in ammonia losses due to combustion and cooling of the liquid ammonia at low-suction pressure with the intermediate pressure. (*A. S. R. E. Journal,* vol. 4, no. 6, May 1918, pp. 549-556, and discussion, pp. 556-560, 4 figs, *dt*)

Rolling Mills

The Slick Wheel Mill. Description of a new process of making car wheels in which they are formed directly from large rolled bars by a rolling-forging process as now applied at the Cambria Steel Works.

The process begins with a cylindrical bar from 18 to 20 in. in diameter, rolled from a standard-size ingot. This bar is introduced into the rotary shear which cuts off short cylindrical blanks of the necessary size. The blanks are then transported to a heating furnace and heated gradually as necessary for the high-carbon steel used in making the wheels. From the furnace they go to a piercing machine which projects a short steel punch way into the center of the blank, making a cylindrical opening in the center thereof, and as this blank is introduced into the wheel mill a loose pin or mandrel which is previously placed in position is projected into the opening. As the wheel is pressed and rolled in the wheel mill this mandrel holds the blank centrally in position and at the same time forms a major portion of the length of the bore of the wheel or blank. The mandrel remains in the wheel or blank as it is rolled and is withdrawn from the mill.

The mill itself includes a pair of dies so arranged that the axis of one of the dies is at an angle to that of the other die. A hydraulic plunger of enormous size projects one die towards its companion die and an electric motor which can develop from 1000 to 2000 hp. is provided for rotating one of the annularly disposed dies, which by friction also rotates the companion die and the blank which is clamped between them and pressed by hydraulic pressure. The blank is shortened and assumes the reverse form of the dies as the pressure and rotation continue.

The time required to roll the blank into a wheel or other annular shape varies from 20 sec. for the smaller sizes with least work to about one minute for the large sizes with more work. A thrust of 3,000,000 lb. or more is taken up by large thrust bearings which are believed to be the largest in the world. These thrust bearings are shown in Fig. 15.

The rotary shear, Fig. 14, employs a pair of large disks arranged with their axes parallel, each disk composed of two pieces mounted on a large shaft and holding clamped between them by means of suitable bolts the shear blades proper. The round bar to be cut is carried on a longitudinal roller of large diameter which supports throughout its length and is adjustable to hold blank bars of different diameters in proper relative position to the shear knives. After one end (forming a blank) has been cut from the bar by the shear rotary knives, the bar is pushed lengthwise of the supporting roller between the side guides by means of a rotary pusher.

The shearing mechanism proper consists of two pairs of rotatable disks to which the eccentric shear knives are clamped.

In order to give a general idea of the large size of this machine, the following dimensions may be noted: The length of the shear proper is about 36 ft.; the length of the feed apparatus is about 60 ft.; and the length of the engine shaft or width of the engine is about 17 ft.; so that the whole apparatus is about 113 ft. long. The width of the shearing is about 18 ft. overall; the height is 13 ft. 8 in. above foundation and its weight approximately 850,000 lb.

The original article is illustrated by numerous line drawings and halftones showing the various details of the machinery

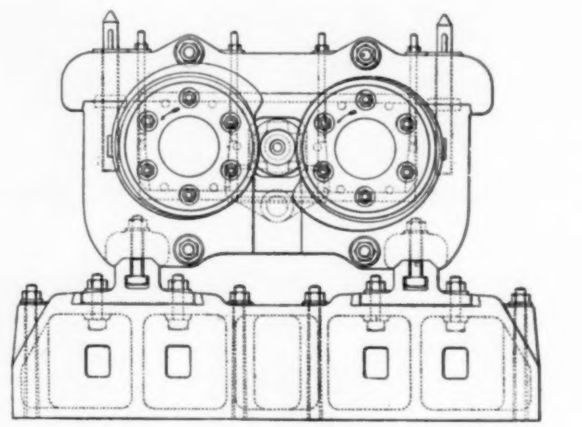


Fig. 14 Slick Rotary Shear

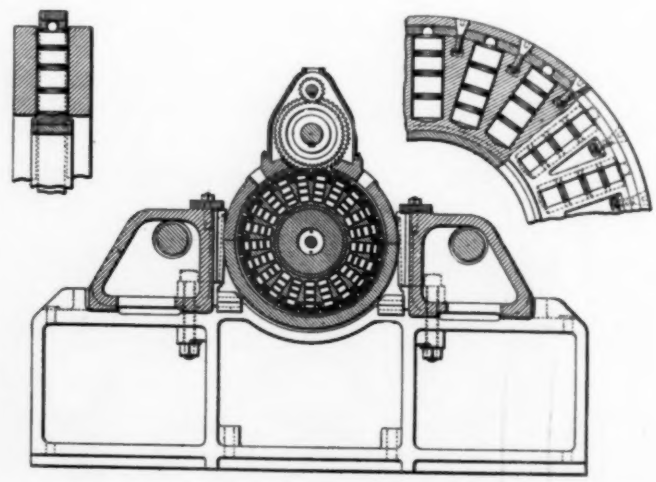


Fig. 15 Annular Thrust Bearings Used in the Slick Wheel Mill

of the wheel mill and of its installation. (*The Iron Age,* vol. 102, no. 9, August 29, 1918, pp. 491-498, 17 figs., *dA*)

Steam Engineering

Wreck of a 25,000-Kw. Turbine in New West End Station, Cincinnati, Ohio. The accident to one of the two 25,000-kw. single-cylinder impulse turbines in Cincinnati occurred on September 4, 1918.

The turbine had been installed about two months previous and had satisfactorily passed the trial load tests. On the morning of September 3, i. e., the day before the accident, the machine was started at 8 o'clock and carried 12,000 kw. all day. At a little before 9.00 a.m. on the day of the accident the erecting crew had about 20,000 kw. on the turbine, which, at first, carried the load well. Then there was a loud bang inside the casing, followed by others accompanied by violent

vibration which shook the station. The throttle was immediately tripped, but the noise and vibration continued, much modified, until the machine slowed down to about 700 r.p.m.

From an inspection it appears that the seventeenth diaphragm was distorted at top and bottom. There are approximately 350 buckets in this diaphragm and all but eleven are burned or crushed.

The blades on this wheel are 28 in. long and made of steel; they have a shrouding over their tips, but use no rosary fastening. It is peculiar that about every tenth blade broke off immediately above where it was fastened on to the wheel, making a clean and sharp break. The blades which remained in the wheel were burned away at their top edges, the projections on the tips of the blades merely showing the effect of having the shrouding pulled away from them.

It is believed that the distortion of the diaphragm was the primary cause of the trouble, this being confirmed by the fact that the projections on the sixteenth diaphragm top and bottom show signs of rubbing on both halves.

It is interesting to note that the turbine was in operation five days after the accident, and, as a matter of fact, could have been put back in service even sooner, had it not been deliberately kept open for the inspection of the engineers of the builders. (*Power*, vol. 48, no. 12, September 17, 1918, pp. 425-426, 3 figs, *d*)

WRECK OF THE 35,000-KW. TURBINE IN NORTHWEST STATION, CHICAGO. On Wednesday, August 1, the 35,000-kw. turbine in the Northwest Station of the Commonwealth Edison Company of Chicago was completely wrecked.

The present article gives the first published seemingly authentic information as to this accident and its probable cause.

The machine carried no load at the time of the accident, but had been in service all day. It was taken off the line shortly after midnight July 31, and the crew arranged to give the machine its regular monthly overspeed run to test the automatic-stop governor, and it was when this test was given that the accident occurred.

The article in *Power* correctly points out that if the stage had been set for observation of the machine, it could not have been better set. The accident actually happened during the test, under conditions ideal for observation of the machine and the taking and recording of the necessary measurements.

According to a statement of the switchboard operator, the speed at which the turbine began to be demolished was that which gave but 26½ cycles (the generator is of 25 cycles), which would mean a speed of 1590 r.p.m., or 6 per cent above the normal speed of 1500 r.p.m.

The steam pressure was 240 lb. and the throttle was wide open for the overspeed test, with the watch engineer standing at the throttle. Then came the thump, severe vibration and a crash as the low-pressure casing burst and pieces of metal flew about the room.

As regards the damage to the turbine the following facts, among others, are recorded as significant: The cast-iron low-pressure casing is blown away from the 18th wheel on. The diaphragms in the last low-pressure stages are broken up and the semi-steel cone supporting these diaphragms is demolished.

The next to the last (19th) low-pressure wheel has a large piece broken out, while the top of the periphery of the last or 20th low-pressure wheel is bent so that it presents a wavy line. The bedplate beneath the outboard-bearing pedestal is cracked.

The conclusion to which the writer comes is that it was the 19th wheel at the low-pressure end that was the first to let go. On the other hand, he does not believe it was the blades on the last two wheels that were torn off by centrifugal force alone.

In this connection, attention is called to an editorial in the same issue of *Power*, on page 355, devoted to the Chicago accident here described and a similar accident in Boston last February.

It is stated that experts who checked the design of the wrecked turbines gave it a factor of safety of four, so far as centrifugal stresses were concerned, but referred to the possibility of stresses being set up by unequal expansion through sudden changes of temperature.

It is significant that both of these accidents occurred immediately after changes in operating conditions, which involved a considerable temperature change in the low-pressure end—the first due to sudden imposition of an excessive load; the second to the taking off of the load. (*Power*, vol. 48, no. 10, September 3, 1918, pp. 345-348, 4 figs., *d*)

A NEW THEORY OF THE STEAM TURBINE, Harold Medway Martin. This is a continuation of an abstract of a serial, the first installment of which appeared in THE JOURNAL, September 1918, p. 784.

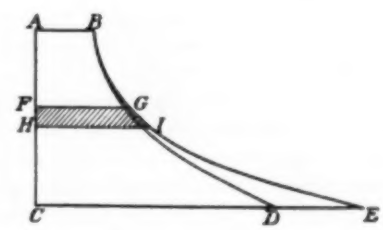


FIG. 16 IDEAL INDICATOR DIAGRAM FOR STEAM TURBINE

In the present installment the writer calls attention to the well-known fact that in steam-turbine practice the gain made by the use of superheated instead of saturated steam is substantially more than is thermodynamically due. This was shown quite conclusively by Baumann in a paper read before the Institution of Electrical Engineers (British) in 1912. Last year an extended set of correction tables drawn up by C. H. Naylor were issued under the auspices of the British Electrical and Allied Manufacturers' Association. From these figures, combined with the heat-drop tables issued by the same association, the present author secured the following figures of relative consumptions under certain standard conditions:

TABLE 1

Superheat, deg. fahr.	0	50	100	150	200	250	300
Relative consumption	1.160	1.101	1.046	1.000	0.9592	0.9235	0.8909

From these figures and other data it would seem that the saving due to a superheat of 150 deg. fahr. is reckoned at 16 per cent instead of at 15 per cent as in Baumann's paper in 1912. This may be due to the improvement effected during recent years in average turbine efficiency, since, as the writer claims, with any given type of turbine the relative gain from using superheat should increase somewhat with the efficiency of the turbine. This is the reverse of the opinion generally held.

From this the writer proceeds to the consideration of the discrepancies between the gains and losses. To do this he takes for purposes of comparison the condition of the steam, not as supplied to the stop valve but after passing through the

governor valve. In addition, the discrepancies are made larger by the fact that the ratio of blade speed to steam speed is, on the average, less the greater the amount of available heat. Furthermore, the heat which becomes available in a steam turbine differs from the adiabatic heat drop and is, in general, considerably larger. The ratio of the two, known as the reheat factor, forms the subject of an important discussion by the writer, who claims that it is substantially greater for superheated than for saturated steam when the latter is assumed to be in thermal equilibrium throughout the whole of its expansion.

Suppose a turbine to consist of an infinite number of stages. At each stage a certain portion of the total energy of the steam is converted into kinetic energy, of which a part is expended in doing useful work on the shaft, and the remainder, which is wasted in friction, is restored to the expanding steam in the form of heat; the consequence is that at each stage the pressure corresponding to a given volume of the steam is somewhat greater than it would be did the turbine work friction-free. Whether steam be used to actuate a turbine or a reciprocating engine the amount of work done down to any stage of the expansion can be represented by an ideal indicator diagram such as is shown in Fig. 16. In this the expansion line *BD* is that corresponding to frictionless working or to unit efficiency, while *BE* represents the expansion line for a turbine working with an hydraulic efficiency η_i. The total area of the diagram is in this case larger than before, because the energy wasted in friction, being returned to the steam as heat, makes the volume at every point of the stroke more than if unit efficiency were attained. On this larger diagram, however, only the fraction η_i is recovered as useful work on the shaft, whereas in the ideal case of unit efficiency the useful work done is represented by the whole of the area *ABDC*. In all cases $\eta_i \times ABEC$ is less than *ABDC*.

The efficiency ratio ε of the turbine is equal to the actual work done divided by that theoretically due from a perfect turbine, or

$$\varepsilon = \eta_i \frac{ABEC}{ABDC}$$

and the reheat factor *R* is defined by the relation

$$R = \frac{ABEC}{ABDC}$$

so that $\varepsilon = \eta_i R$, where η_i is known as the hydraulic efficiency of the turbine.

The actual thermodynamic head under which any turbine works is therefore not represented by the adiabatic heat drop *u*, but by a larger quantity *U*, where $U = Ru$.

From this the writer proceeds to show how to determine the value of the reheat factor corresponding to different values of the hydraulic efficiency of the turbine and comes to the expression

$$R = \frac{1}{\eta_i} \cdot \frac{1-\left(\frac{1}{x}\right)^{\eta_i[1-(1/\gamma)]}}{1-\left(\frac{1}{x}\right)^{[1-(1/\gamma)]}}$$

where η_i is the hydraulic efficiency of the turbine and x the ratio of the initial to the final pressure. From this he derives the values of the reheat factor for superheated steam throughout the whole range of its expansion for the various hydraulic efficiencies given in Table 2.

In other words, the efficiency ratio of a turbine is defined as the product of its hydraulic efficiency and the reheat factor.

In view of its use elsewhere in this discussion attention is called to the following expression for λ:

$$\lambda = \frac{1+\frac{1}{\gamma-1}}{\frac{1}{\gamma-1}+k}$$

where γ is the index when the expansion is adiabatic.

Among other things the writer calls attention to the paradox following from the above expression for the reheat factor *R*. If the expansion be carried far enough, the efficiency ratio is independent of the hydraulic efficiency which can be shown by making $x = \infty$. Since then the efficiency ratio is equal to $R\eta_i$, its value is always unity if the expansion be carried to zero pressure. The following physical explanation is given: To reduce the final pressure to zero we must go down to the absolute zero of temperature. In deducing the value of *R* it was assumed that all the heat energy not expended in doing useful work was restored to the fluid in the form of heat. At the absolute zero of temperature the working fluid retains no

TABLE 2 REHEAT FACTOR FOR STEAM SUPERHEATED THROUGHOUT THE WHOLE RANGE OF ITS EXPANSION

Values of $x = \frac{p_0}{p_1}$	Hydraulic Efficiency η			
	0.5	0.6	0.7	0.8
1	1.0000	1.0000	1.0000	1.0000
2	1.0393	1.0312	1.0235	1.0160
4	1.0753	1.0629	1.046[illegible]	1.0310
6	1.1033	1.0809	1.0602	1.0397
8	1.1195	1.0934	1.0695	1.0454
10	1.1310	1.1024	1.0762	1.0494
15	1.1554	1.1209	1.0891	1.0585
20	1.1691	1.1313	1.0964	1.0617
25	1.1841	1.1445	1.1057	1.0692
50	1.2219	1.1718	1.1253	1.0810
100	1.2586	1.1998	1.1450	1.0932
200	1.2962	1.2279	1.1643	1.1053

TABLE 3 REHEAT FACTORS *R* FOR STEAM INITIALLY IN THE DRY BUT SATURATED CONDITION, AND EXPANDED FROM DIFFERENT INITIAL PRESSURES DOWN TO 1 LB. ABSOLUTE, THERMAL EQUILIBRIUM BEING MAINTAINED THROUGHOUT THE EXPANSION

Abs. Initial Pressure, lb. per sq. in.	Abs. Final Pressure, lb. per sq. in.	Hydraulic Efficiency				
		0.5	0.6	0.7	0.8	0.9
2	1	1.0085	1.0078	1.0065	1.0046	1.0022
4	1	1.0191	1.0163	1.0129	1.0089	1.0043
6	1	1.0284	1.0217	1.0169	1.0114	1.0056
8	1	1.0316	1.0256	1.0195	1.0130	1.0062
10	1	1.0355	1.0290	1.0221	1.0148	1.0071
15	1	1.0435	1.0348	1.0264	1.0181	1.0078
20	1	1.0496	1.0394	1.0294	1.0191	1.0088
25	1	1.0537	1.0427	1.0318	1.0210	1.0104
50	1	1.0669	1.0531	1.0394	1.0261	1.0129
100	1	1.0809	1.0640	1.0475	1.0313	1.0155
200	1	1.0956	1.0755	1.0559	1.0368	1.0162

heat energy and the latter has accordingly all been turned into useful work and the efficiency ratio is unity, however great the frictional losses may have been at each stage of the turbine.

The writer points out that the error in reheat factors for wet or saturated steam is considerable, because for the adiabatic expansion of such steam in thermal equilibrium the expression of the form pV^n = constant (where $n = \gamma$), is only moderately

accurate. In such a case the reheat factor may be determined in another way, published in *Engineering* several years ago, The writer repeats the argument presented there and gives a table showing the value of reheat factor for steam unusually dry and expanding in thermal equilibrium throughout, that is to say, with no undercooling, a condition which is, however, not realized either in a steam turbine or in a reciprocating engine. These values are given in Table 3.

The writer makes the following comparison of Tables 2 and 3. Suppose a steam turbine designed to give an hydraulic efficiency of 0.7 for the range of expansion of from 200 lb. absolute down to 1 lb. absolute. Then if the steam supply is saturated and the expansion takes place in thermal equilibrium throughout, its thermodynamic efficiency ratio will, from Table 3, be $0.7 \times 1.0559 = 0.739$ nearly. If, on the other hand, the turbine is designed to give the same hydraulic efficiency with steam supplied at 200 lb., and superheated to such an extent that the superheat is not lost when the exhaust port is reached, the efficiency ratio will be $0.7 \times 1.1643 = 0.815$ nearly. Hence, with the same hydraulic efficiency the thermodynamic efficiency ratio will be fully 10 per cent more with superheated than with saturated steam expanding in thermal equilibrium.

It will be obvious, therefore, that the adiabatic heat drop forms a somewhat fallacious foundation for estimating the saving to be effected by superheating the steam. (*Engineering,* vol. 106, no. 2742, July 19, 1918, pp. 53-55, 3 figs. The article is to be continued, *tA*)

The 45,000-Kw. Compound Turbine at Providence, R. I., J. P. Rigsby. Description of a turbo-generator unit recently put in operation at a local power plant in Providence, R. I. It is of the Westinghouse cross-compound, double-unit type, the high- and low-pressure sides each driving a generator of 22,500 kw. capacity. These generators are mounted on separate bedplates supported on foundations parallel to each other.

The energy given up by the steam at full load is equally divided between the high- and the low-pressure turbines, though at lower loads a greater proportion is carried by the high-pressure element. The steam pressure at the throttle is set at 200 lb. with 100 deg. fahr. superheat and a vacuum of 29 in. in the exhaust. At the high-pressure element the speed is 1800 r.p.m. and at the low-pressure element 1200 r.p.m.

Several features of construction of the turbine are of particular interest. Thus, the high-pressure spindle consists of a hollow steel drum about 3 ft. in diameter carrying most of the blading. There are two blade rings of larger diameter at the one end and corresponding dummy rings or balance pistons on the other. The spindle ends are pressed into the drum and are secured with T-headed shrink links, which are themselves held in place by the blade and dummy rings.

The low-pressure spindle consists of a central hollow drum rigidly secured to the spindle ends with two disks mounted upon each of these ends. These disks carry the low-pressure blades, the maximum mean velocity of which is so low that ordinary good cast steel can be used in the blade rings.

The condenser equipment is claimed to be the largest in the world. The condenser unit is composed of two separate and distinct low-level jet condensers, which can be operated together or separately, if necessary. The same water level is maintained in each condenser by the use of a water-equalizing connection between the two pump bodies. This water-equalizing connection is so constructed that no surges occur between the condensers. For this purpose a connection is made in the form of a tee, the bottom of which forms a reservoir, and a baffle running almost to the bottom prevents surging; also an air-equalizing connection is provided to maintain the same vacuum in each condenser. (*Power,* vol. 48, no. 9, August 27, 1918, pp. 292-298, 9 figs., *dA*)

Varia

Einstein's Gravitation Theory, I, II, III and IV, H. A. Lorentz (*K. Akad. Amsterdam,* Prov. 19, pp. 1341-1369, and 20, pp. 2-34, 1917). The author considers that through the Einstein equations the general theory of relativity may now be regarded as having assumed a definite form. He attempts, in the present communication, to prepare the way for its future development and application to special problems: (1) by presenting the fundamental ideas in as simple a form as possible, (2) by showing how Einstein's differential equations for the gravitation field can be derived from Hamilton's principle, and, in connection therewith, dealing with the energy, stresses, momenta, and energy currents in that field. By means of a four-dimensional geometric representation it is shown that any system consisting of material points and an electromagnetic field is expressible in terms of a single quantity H occurring in the variation theorem, and which is called the *principal* function. It consists of three parts, referring respectively to the material system, the electromagnetic field and the gravitation field, the material points being assumed to have no connection other than that resulting from their gravitational attraction. Space and time are combined in the four-dimensional extension R_4, a point P in which indicates a definite place at a definite instant. The curve traced out by P when the time coördinate only varies is called, after Minkowski, a *world line,* so that an intersection of two world lines represents the coincidence, at a certain moment, of the two objects to which they belong. It should be noted that a propagated light wave will have its world line. And Einstein observes that our observations can determine only these coincidences, so that if astronomical data could be extended arbitrarily and without limit, a gravitation field, e.g., that of the sun, with its material points and light waves; would be completely defined by a field figure consisting of the world lines in R_4, drawn so that each observed coincidence is represented by an intersection of two lines, and so that the points of intersection succeed each other in the right order. It should therefore be possible to express the fundamental laws of physical phenomena by geometric considerations referring to the field figure in such manner that this mode of expression shall be the same for all possible field figures. The introduction of coördinates is of secondary importance in a geometrical treatment of this kind, and employed by the author only to obtain the equation representing the connection between the electric and magnetic forces, on the one hand, and the charge and convection current, on the other; and to establish the general equations, which are required for the solution of special problems. Since coördinates play no essential part in the general discussion of principles, the latter must necessarily be independent of the actual coördinates chosen, so that the general covariancy of the equations postulated by Einstein is assured beforehand. (Taken from *Science Abstracts,* Section A—Physics, vol. 21, pt. 7, no. 247, July 31, 1918, pp. 282-283, *g*)

CLASSIFICATION OF ARTICLES

Articles appearing in the Survey are classified as *c* comparative; *d* descriptive; *e* experimental; *g* general; *h* historical; *m* mathematical; *p* practical; *s* statistical; *t* theoretical. Articles of especial merit are rated *A* by the reviewer. Opinions expressed are those of the reviewer, not of the Society.

SOCIETY AFFAIRS

A Record of the Current Activities of the Society, Its Members, Council, Committees, Sections and Student Branches; and an Account of Professional Affairs of Interest to the Membership

THREE MILLION men at the front by July 1, 1919, is more easily attainable than the industrial readjustment by that time to maintain three million men. The most important task before the country is that of industrial readjustment, the work peculiarly that of the engineer.

On the occasion of a recent visit to Washington with regard to the essential curtailment of the paper used in the Society's publications, the Secretary had an opportunity to take up with Mr. C. A. Otis, Chairman of the Resources and Conversion Division of the War Industries Board, the work of the Society's Committee on War Industries Readjustment, and was pleased to learn that this was eminently satisfactory. In fact, Mr. Otis warmly complimented the Society for its enterprise. The task is stupendous, however. It is more than the Administration in Washington, no matter how powerful or well organized, can complete alone. It must be done by individuals throughout the United States. Hence this appeal through our members and to all they can influence, to undertake only such activities as have a direct effect on winning the war.

Through our Local Sections, corresponding to the Regional Committees of the War Industries Board, any member may secure information, either as to what are the prospective requirements of our Government on the one hand, or to place before the proper authorities the information respecting the abilities of any plant to undertake work. In other words, our Society, through its several committees, is able to act as one of the clearing houses of the Government in this essential work of readjustment.

Another essential work of the people of the United States is that of invention, and here again the Society is prepared to act as a clearing house to ascertain on the one hand the problems to be solved and on the other hand to offer the special abilities of individuals who are prepared to give all or a portion of their time either at places designated by the Government or at their offices or homes.

In connection with these very essential activities of the Society, you will note in the program of the coming Conference at Indianapolis that we are to have the subject of research treated authoritatively by the head of the Mechanical Engineering Division of the National Research Council, Prof. W. J. Lester. Professor Lester is a very forceful and fluent speaker.

The above are the immediately obvious requirements of the hour which every member will naturally wish to undertake. The more far-reaching and fundamental activities of the Society, however, are those of setting and maintaining the ideals of the engineering profession. In connection with the Indianapolis Conference on October 25-26, an opportunity is to be afforded representatives from each of the Sections in the United States to bring together the point of view of the membership on the great questions of engineering ideals; and we are to have a "self-examination," as some friend has called it. It is hoped that in the following month the Local Sections all over the United States will further discuss this matter by calling on their respective representatives to report the results of the Indianapolis Conference. Then at the Annual Meeting in December there will be a still more representative gathering of engineers from all over the United States for a further discussion and statement of the objects and aims of a professional engineering society. All those members who cannot attend the Indianapolis meeting are urged to write their views, and failing also to attend and speak at the Annual Meeting in New York, they should write to the Secretary.

During the war, views of the world and the members of the engineering profession have undergone a change and it behooves the Society, as expressing the thoughts and ideals of the profession, to lead in that expression.

Calvin W. Rice,
Secretary.

The Coming Annual Meeting

Plans for the Annual Meeting, to be held December 3-6, have so far developed that tentative announcement of several of the sessions can now be made. The practice in previous years of having a leading subject for the meeting of broad, general interest, will be adhered to, with a discussion throughout the day on Wednesday, December 4, of the general topic on Human Engineering, particularly in reference to questions of administration which have arisen in the war industries. The titles of the papers now in preparation for this session are as follows: Organization; Standardization and Administration of Wages; Non-Financial Incentives; Incentive of Control in Industry; Employment of Labor; Dilution of Labor; Intensive Training; Human Relations in Industry.

There will be at least two sessions for general papers of technical interest for which an ample variety of strong contributions have been received.

One session will be under the auspices of the Gas Power Sub-Committee with papers on oil engines and cooling losses in combustion engines. Another session will be in charge of the Sub-Committee on Textiles, with papers on industrial power problems and aeroplane fabrics. A session arranged by the Sub-Committee on Machine Shop Practice will be devoted to the subject of gages, methods of manufacture and testing. The apparatus in the Department of the Bureau of Standards, located in the Engineering Societies Building, New York, will be added to with a view to placing the equipment on exhibition during the meeting.

Another session will be a joint session with the American Society of Refrigerating Engineers, which holds its annual convention simultaneously with that of our own Society. Papers will be contributed by both societies.

Everything points to a most successful meeting, equal if not exceeding those of the last two years which have been the largest in the history of the Society. On Wednesday and Thursday evening of the meeting there are to be addresses or moving pictures relating to the war, and the trend of many of the papers at the special sessions will be in the direction of the work which the members of the Society and other engineers are accomplishing in the one all-absorbing undertaking of the present time. It is expected that complete details will be given in The Journal for November, together with abstracts of the papers.

Women's Auxiliary of the A. S. M. E.

The organization meeting of the Women's Auxiliary of the A.S.M.E. was held at Society headquarters on September 20, at the call of Mrs. Charles E. Davis, whom President Main had appointed as representing this Society at the invitation of the Council of Organizations for War Service. The families of all local members were invited, and formed an enthusiastic gathering. The meeting was addressed by Miss Esther Lape, Secretary to the Section on Aliens of the Council of Organizations for War Service, who told the ladies of the work to be done in the War Information Centers of the city.

It was voted to organize under the following officers: Mrs. Charles E. Davis, Chairman; Mrs. E. J. Prindle, Vice Chairman, and Mrs. Jesse M. Smith, Secretary.

The Committee plans to circularize the ladies shortly for volunteer service along these lines.

Commission to Standardize Screw Threads

The Act recently passed by Congress for the appointment of the Commission to Standardize Screw Threads is now a law and is being carried out, and it is expected that within a few days Secretary Redfield will have officially announced the names of the members of the Commission.

An informal organization meeting was held recently in Washington in which extensive preparations were made for carrying out this important standardization work. Manufacturers of every kind of screw thread, no matter for what purpose, whether they be screws for use on battleships, in rolling mills, machine tools, looms or surgical instruments, typewriters, etc., will be requested to furnish the Commission, whose headquarters will be at the Bureau of Standards, Washington, with complete information as to the type of thread they are using. It is particularly desired that they list each size manufactured, stating the pitches, system and form of thread, the tolerances, nomenclature, the gages in use and the methods of testing and gaging.

This information will be carefully collated by the Secretary to the Commission, and all manufacturers and others interested will be invited to appear before the Commission in order that their particular form of product may have proper consideration.

The Commission is arranging a series of meetings in Washington, D. C., and in other parts of the country, at which all manufacturers will have an opportunity for a hearing.

A questionnaire is to be sent out at once, and manufacturers who for any reason fail to receive a copy should apply immediately, addressing the Secretary of the Screw Thread Commission, Bureau of Standards, Washington, D. C

New Volume of Transactions

Volume 39 of Transactions is now being issued to the membership. It contains an account of the activities of the Society for 1917, the year in which the United States entered the great war. The volume includes the papers and addresses given at the Spring and Annual Meetings and a selection of papers presented at meetings of the Local Sections. Inevitably many of these relate to problems with which engineers are concerned in the prosecution of the war and to which, with patriotic devotion, they are giving their undivided thought and attention.

At the beginning of the war this Society, in common with many others, tendered its services to the President of the United States. The offer was promptly accepted to the great satisfaction of the membership, and as the needs of the Government have grown the Society has responded to the many requests which have come to it.

Individually, also, the members have heeded the call and are serving in almost every department of the Government, abroad at the front, at the Nation's Capital, in arsenals, navy yards, shipyards, aviation fields, etc., and in the industries of the country engaged in munitions manufacture. The earnest and helpful spirit resulting from these many points of contact is reflected in the pages of this volume.

Eighth Volume of Condensed Catalogues

The eighth annual volume of the A. S. M. E. Condensed Catalogues is now coming from the press and it is with much pleasure that the Society records a further considerable gain in size and comprehensiveness of this useful volume.

Four hundred and fifteen firms, including a majority of the leading manufacturers in their respective lines, are represented by publication of catalogue data. The General Mechanical Equipment Directory, in which all eligible manufacturers are entitled to listing of their products free of charge within reasonable limits and irrespective of the use of space, has also been extended and improved and it is believed that this reference feature will prove of even greater value than heretofore. The Engineering Data Section contains, in addition to the usual material, a complete list of Transactions papers beginning with the first volume issued in 1880.

U. S. Navy Needs Steam Engineers

The urgent demand for engineers to man the supply and cargo ships of the U. S. Navy has forced the Navy Department to redouble its efforts for obtaining men adapted for this service. It is fully realized that there are many men at the present time who are anxious to join the service, but do not know where they fit in. The U. S. Navy Steam Engineering School at Hoboken, N. J., is giving a five-months' course in steam engineering to those men who are able to qualify. It has been found that those men who have either a mechanical or electrical engineering degree or have pursued these courses, and have not graduated, but have had sufficient practical training, constitute excellent material. Many men who are not technical graduates, but have had practical experience covering a number of years have also qualified.

Through arrangement with the War Department the Navy will be permitted to induct, individually, through its local board, a given quota of men, who have special qualifications. Application for this school should be sent to Ensign C. L. McIntyre, 225 West 42nd St., New York City.

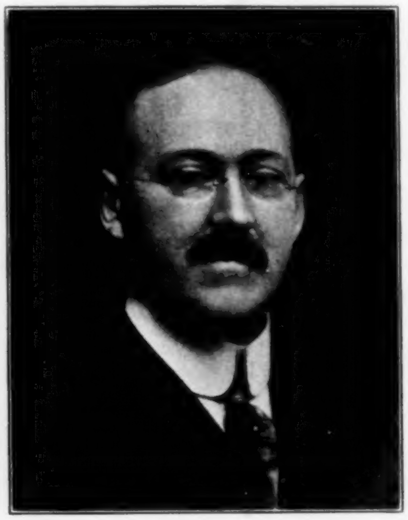
Committee on Aims and Development

The Council, at its meeting on September 20, authorized a Committee on Aims and Organization to discuss and formulate aims of the Society in the light of modern development and present-day thought, and to assist toward finding a method of coöperation with the rest of the engineering profession suitable to carry out these aims. The Committee is being appointed by the President, and consists of one delegate from each of the Local Sections, and a number of members-at-large selected by the President. It is planned to hold a general meeting of the Committee in Indianapolis, October 24-26, coincidentally with the meeting of the Council and of the Mid-Western Sections in that city, and the President will appoint an Executive Committee from the general committee to lay out the program of work.

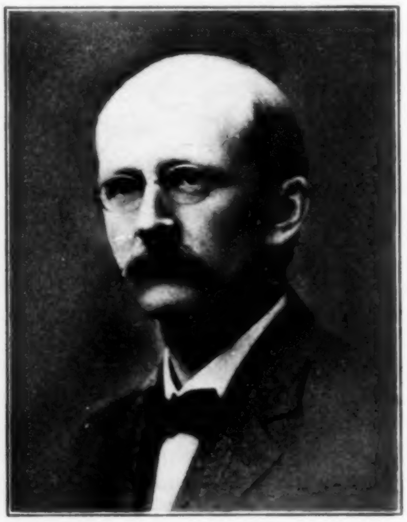
CHAIRMEN OF STANDING COMMITTEES OF ADMINISTRATION NOW MEMBERS OF THE COUNCIL

IN accordance with the amendment to C 45 of the Constitution, which became effective at the last Spring Meeting, the Standing Committees of Administration now consist of the following: Finance, Meetings and Program, Publications and Papers, Membership, Local Sections and Constitution and By-Laws. The appointment, organization, duties and terms of service of these committees are to be designated by the By-Laws.

ROBERT M. DIXON
Finance



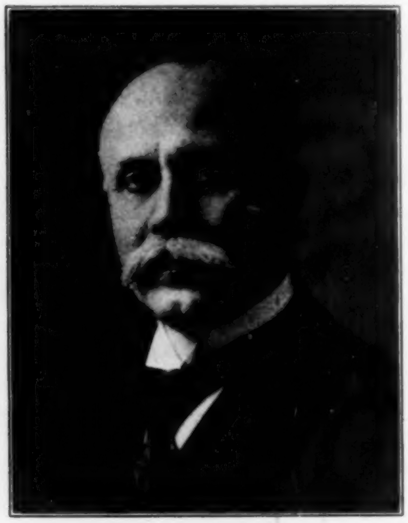
L. P. ALFORD
Meetings and Program



GEORGE A. ORROK
Publications and Papers

HOSEA WEBSTER
Membership

D. ROBERT YARNALL
Sections



JESSE M. SMITH
Constitution and By-Laws

An important feature of the amendment is that the chairman of each of the Standing Committees of Administration shall have a seat in the Council of the Society, although they have no vote. At the Council meeting held last month, these chairmen were, for the first time, privileged to take part in the proceedings in their new capacity as committee representatives.

This is an important step in the Society's development. It assures that those who are directing its fundamental activities will meet together once a month with the other members of the Council and there present for consideration the important interests which they represent. It will undoubtedly facilitate the prompt transaction of business and enhance the coördination of effort which is so essential in a large organization.

In view of the initiation of this forward step at the present time, we are pleased to publish in this number of THE JOURNAL the portraits of the several chairmen. Four of these chairmen become new members of the Council, one of these, however, Mr. Jesse M. Smith, Past-President of the Society, having previously had long service as a Council member. The other two committee chairmen, Mr. R. M. Dixon of the Finance Committee, and Mr. D. Robert Yarnall of the Sections Committee, were already Council members.

Coöperation Between the A.S.M.E. and the War Industries Board

ONE of the important recent activities of the Society has been the work of its War Industries Readjustment Committee and its Regional Representatives in aiding manufacturers throughout the country in the adaptation of their plants to the production of war material, as outlined in THE JOURNAL for August 1918, page 695.

This matter originally came up at a meeting of the New York Local Section on non-essential industries held last February, after which a committee was appointed to investigate and report. This led to the appointment of a permanent committee in June, consisting of G. K. Parsons, *Chairman*, Erik V. Oberg and Fred A. Scheffler.

Later, this work was taken up on a broad scale by the War Industries Board of the U. S. Government, through its Resources and Conversion Section, of which Mr. Charles A. Otis is chief. A War Resources Committee and a Regional Advisor were appointed by the Government in each of 20 sections, or regions, of the United States for the purpose of organizing the various lines of trade in the different regions.

As soon as this plan was announced, our President, Mr. Charles T. Main, immediately appointed a Regional Representative of the Society in each of these 20 regions to coöperate with the War Resources Committees and the Regional Advisors of the Government.

In this connection it will be of interest to describe what has been done by our War Industries Readjustment Committee, the chairman of which, Mr. G. K. Parsons, is Regional Representative in Region No. 3 (New York), in coöperation with the local Regional Advisor of the Government in this region, Mr. William F. Morgan. This committee of the Society has been called upon to make a number of industrial surveys for Mr. Morgan for a number of different purposes, such as:

1 To determine the wisdom of the Government's letting contracts for certain munitions to particular manufacturers.

2 To determine whether the essentiality of the products of a certain corporation, together with its probable future requirements, were sufficient reason to warrant permitting it to increase its capital stock.

3 To determine the fitness of certain plants for the manufacture of products which had never been manufactured there before, and the ability of the prospective management to establish the essential industry in question.

4 A study of various industries to determine what sort of essential work they can best be adapted to.

The foregoing illustrates, not only to our regional representatives, but to others, how our members can best render assistance in this work. A plant which can take on war work, as well as those plants which are overburdened with war work and would like the assistance of some other plant on part of its work, should notify either the Regional Advisor of the Government, or the Regional Representative of the Society, whose headquarters are nearest at hand.

When a manufacturer notifies the Regional Advisor of the War Industries Board that he is in a position to accept orders for war work he should be prepared to state specifically just what class of articles he can manufacture and the rate of production. Also in certain instances it will be advisable for the manufacturer to state the number and class of help employed, the number, size and type of machines which the plant contains.

Following is a list of the Regional Advisors of the War Industries Board and of our Regional Representatives:

Regional Representatives
War Industries Readjustment Committee

Boston, A. C. Ashton, 33 Columbus Ave., Somerville, Mass.
Bridgeport, Harry E. Harris, Post Office Box 852.
New York City, G. K. Parsons, 29 Pine St.
Philadelphia, C. N. Lauer, Day & Zimmermann.
Pittsburgh, J. M. Graves, 435 Sixth Ave.
Rochester, Ivar Lundgaard, 208 Culver Rd.
Cleveland, F. H. Vose, 3203 Whitehorne Rd., Euclid Heights.
Detroit, E. J. Burdick, 511 Seminole Ave.
Chicago, A. D. Bailey, 21 Elmwood Ave., LaGrange, Ill.
Cincinnati, Fred A. Geier, 2301 Grandview Ave., E. W. H.
Baltimore, Wm. W. Varney, 710 North Carey St.
Atlanta, Robert Gregg, 960 Ponce de Leon.
Birmingham, W. P. Caine, Tenn. Coal, Iron & R. R. Co., Ensley, Ala.
Kansas City, J. L. Harrington, Rockhill Manor.
St. Louis, R. L. Radcliffe, 701 Laclede Gas Bldg.
Milwaukee, W. M. White, 747 Summit Ave.
San Francisco, B. F. Raber, 2027 Delaware St., Berkeley, Cal.
Dallas, A. C. Scott, Scott Engineering Co.
Seattle, R. M. Dyer, Puget Sound Bridge & Dredging Co.
St. Paul, Oliver Crosby, 63 S. Robert St.

Regional Advisors
War Industries Board

Boston, Stuart W. Webb, Chamber of Commerce.
Bridgeport, B. D. Pierce, Jr., 1st Bridgeport Nat'l. Bank Bldg.
New York, Wm. F. Morgan, Merchants Assn. of New York.
Philadelphia, Ernest T. Trigg, 1228 Widener Bldg.
Pittsburgh, Geo. S. Oliver, Chamber of Commerce.
Rochester, E. A. Fletcher, Chamber of Commerce.
Cleveland, W. B. McAllister, Chamber of Commerce.
Detroit, Allan A. Templeton, Detroit Board of Commerce.
Chicago, D. E. Felt, 29 S. LaSalle St.
Cincinnati, Edwin C. Gibbs, 31 E. 4th St.
Baltimore, S. F. Shavannes, Merchants & Mfrs. Assn.
Atlanta, Edw. H. Inman, Chamber of Commerce.
Birmingham, T. H. Aldrich, 322 Brown-Marx Bldg.
Kansas City, Franklin D. Crabbs, 10th & Central Sts.
St. Louis, Jackson Johnson, 510 Locust St.
St. Paul, D. R. Cotton, 1414 Pioneer Bldg.
Milwaukee, August H. Vogel, 4th Floor, City Hall.
Dallas, Louis Lipsitz, 407-9 Southland Life Bldg.
San Francisco, Frederick J. Koster, Chamber of Commerce.
Seattle, Herbert Witherspoon, Chamber of Commerce.

Resolutions by Committee on Public Relations

The following resolutions of the Public Relations Committee of the Society, Dr. F. H. Newell, *Chairman*, constitute a progress report of the committee and offer a constructive statement regarding the status of the engineer in public affairs—his obligations to the public and his opportunity for leadership:

1 The object of this Committee is to give special attention to those matters not specifically covered by the work of other Committees and which have to do with the larger relations of the Society and of its members to the public.

2 Because these relations have not been kept continuously prominent nor widely emphasized, there has been more or less misapprehension on the part of the public as to the work of the Society and of its members, especially in larger affairs of general concern. It is obviously the duty of this Committee to do what it can to improve this understanding.

3 In the rapid evolution of affairs, the engineer as a man and citizen, in order to hold his proper position relative to other professions and callings and to do his part, must be continually alert in keeping the public aware of the fact that the great work of war and of peace is that of the engineer and that in this he should be a leader. In order to fully employ his ability he must enjoy a proper appreciation and be free from the limitations which may be imposed by others who do not possess a wide view of engineering achievements and possibilities.

4 While it is realized that there must be radical changes in the education of the engineer to enable him in the future to fill the requirements of larger leadership, yet at the present time much can be accomplished by the present organizations devoting time and energy to progress in other than purely technical lines. The engineering society to meet present conditions should seek advance in those matters which aid the engineer in being more effective, outside as well as inside his purely technical occupations.

5 In seeking such advance it is practical to learn from other associations of educated men holding similar high ideals and which

have worked out practical methods for achieving results, such for example as the Architects, the Commercial Clubs, the Doctors and Lawyers.

6 There is need of a well-considered scientific study of the ways which have been found advantageous by such organizations and a comparison of their methods and conditions with those of the mechanical engineer.

7 Growing out of such study should be the development of a carefully considered plan designed to put the engineer in the best possible relation with the public, not directly for private gain or gratification, but in order that each man may perform his largest functions for the benefit of society and that he may fulfill more completely the duties which come to him because of the fact that he has been educated partly at public expense and as an educated man has superior obligations to the world about him.

8 Following such study should be an awakening of the membership to the fact that the engineer as a man can and should occupy a position of wider initiative and leadership in public affairs. This can best be done by a carefully-thought-out series of papers on the subject.

9 At the same time the public should be educated to an appreciation of the fact that the engineer can and should perform still larger functions with corresponding benefit in increased comfort, health and prosperity of the community.

10 Organized effort should be made to anticipate action by officials in appointments to places of responsibility which because of the nature of the work should be filled by engineers. It should be made difficult, if not impossible, for the position of director or superintendent of public works and construction to be filled by other than men having an engineering education and experience.

11 There should be facilities provided for exchange of ideals and experience among engineers in the public employ, giving them the information and moral support in their efforts for higher public service.

12 While any betterment in the status of the engineer in the long run will redound to the benefit of the public, the profession should constantly be reminded that its position in the community will be conditioned largely by what it does for the public. In striving toward any widening of influence in American life our dependence must be on actual service rather than on any demand for recognition, no matter how logical.

ALL SHOULD COME TO INDIANAPOLIS

October 25 and 26

BY the time this issue of THE JOURNAL is in the hands of the members the final program of the big joint meeting of the Mid-Western Sections, to be held in Indianapolis on October 25 and 26, in connection with the Council meeting there, will have been completed. As now determined, the event at Indianapolis comprises the Council meeting on Friday morning, the joint meeting of the Indianapolis, Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, and, it is hoped, Cleveland Sections, together with a meeting of the new Committee on Development of the Society, and a meeting of the Fuel Conservation Committee of the Engineering Council. The Indiana Engineering Society, the Indianapolis-Lafayette section of the American Institute of Electrical Engineers and the Indianapolis section of the Society of Automotive Engineers have also been invited to participate.

The Indianapolis Committee is in charge of the arrangements. This committee comprises:

LAWRENCE W. WALLACE, Chairman, Asst. General Manager, Diamond Chain & Mfg. Co.

W. A. HANLEY, Vice-Chairman, Chief Engineer, Eli Lilly & Co.

B. G. MERING, Treasurer, Industrial Engineer, American National Bank Bldg.

CHARLES BROSSMAN, *Secretary*, Consulting Engineer, 1616 Masons' Bank Building.

GILBERT A. YOUNG, head of M. E. Department, Purdue University, Lafayette, Ind.

F. C. WAGNER, Professor Mechanical and Electrical Engineering, Rose Polytechnic Institute, Terre Haute, Ind.

The Local Committee will be glad to furnish any one information on transportation to Indianapolis, and will secure hotel accommodations, arrange to meet visitors at the trains upon notification, etc.

HEADQUARTERS

The headquarters of the meeting will be the Claypool Hotel, where also the two professional sessions scheduled and the committee meetings will be held. While the hotel has ample accommodations for a large number of guests, and while no overcrowding is anticipated at this season of the year, members intending to go to Indianapolis should get in touch with the Local Committee and ask them to secure reservations for them in advance. The Local Committee intends to immediately issue to all members information on the cost of accommodations, on transportation, and also a copy of the final program.

PROGRAM

As determined at the time of going to press with THE JOURNAL, the program is as follows:

Friday, October 25

9:30 a. m. Registration at Claypool Hotel.

9:30 a. m. Meeting of the Council.

11:30 a. m. Meeting of the Committee on Local Sections and members of the Executive Committees of the Mid-Western sections.

12:30 p. m. Informal luncheon at the Claypool. The Mayor of Indianapolis is confidently expected to welcome the visitors and President Main to respond.

2:00 p. m. Symposium on Fuel Conservation:

An Explanation of the Regulations of the Fuel Administration, by Dr. P. B. Noyes, Director of Coal Conservation, U. S. Fuel Administration.

What the Fuel Administration Expects of the Engineers, by David Moffat Myers, Advisory Engineer, U. S. Fuel Administration.

Discussion, in which the Administrative Engineers of the Fuel Administration and members of the Society will participate.

6:30 p. m. Informal dinner, at which nominee for President M. E. Cooley, is expected to speak, followed by war pictures.

Saturday, October 26

9:00 a. m. Symposium on Research.

Opening address by Professor Walter Rautenstrauch, member of the Society's Committee on Research.

Address by Dr. W. J. Lester, Vice-Chairman of the Mechanical Engineering Division of the National Research Council.

Discussion by members of the Society.

11:30 a. m. Exhibition of the Liberty Motor.

12:30 a. m. Informal luncheon at place arranged by the Local Committee. Members and guests will be conducted in automobiles.

The afternoon will be free for excursions, and the local committee is making arrangements to be announced.

The Local Committee hopes to arrange for members to visit both the Columbia Club, the features and functions of which are so unique as to call attention to it all over the country, and the Canoe Club, which has a large membership of professional and business men, and a splendidly equipped building.

Committee Meetings

Committee meetings other than the ones listed on this program include a meeting of the new Committee on Development, which is a committee appointed by the President and confirmed by the Council to inquire into the aims and activities of the Society in a similar manner to the committees of the Civil Engineers and the Mining Engineers. This committee consists of delegates from each of the Local Sections and members at large appointed by the President, and it is expected that the entire committee will be present at the Indianapolis meeting. The meeting of this Committee will, it is hoped, commence on Thursday afternoon and continue throughout the whole time at Indianapolis.

The Fuel Conservation Committee of the Engineering Council, which is connected with the Bureau of Mines and with the Fuel Administrator and is studying and devising problems of fuel utilization, especially coal, will meet at a time and place to be determined.

Let Every Nearby Member Attend

The Committee on Local Sections and the Local Committee of the Indianapolis Section assure all members who go to this meeting and who bring their friends, a profitable and enjoyable time. Special arrangements will be made to take care of visiting ladies and no pains will be spared to make this meeting, which is the first of a series of joint meetings planned by the Sections Committee, an occasion of benefit. The period of the meeting is planned so that members who attend will be inconvenienced in their work as little as possible. They will be able to get in four days' work in the week and spend the week-end in Indianapolis.

Indianapolis is the largest inland city on the American continent and one of the most important railroad centers in the country. It is also one of the handsomest cities and one of the most prosperous and progressive. Its growth has been practically that of two decades. It is the commercial, social, educational, political and governmental center of Indiana and is more typically the capital of a state than any other like city in the country. It is situated 60 miles from the center of population of the United States, and is within the geographical center of manufacturing. The city has more than 1200 factories; in the output of automobiles it is the second city in the country.

AMONG THE SECTIONS

Cleveland Section

At the September meeting of the Council the petition of the members of the Society residing in Cleveland for a Local Section in that vicinity, duly passed by the Committee on Local Sections, was approved. This new Section comprises the towns or cities of Akron, Barberton, Bedford, Chardon, Cleveland, Cuyahoga Falls, East Cleveland, Elyria, Hudson, Kent, Lakewood, Lorain, Massillon, Quarryville, Ravenna, Sandusky, South Euclid, Wickliffe, Willoughby, and Wooster, totaling a Society membership of approximately two hundred and sixty at the present time, the sixth largest in the country.

The new Section comes into being as the mechanical-engineering section of the Cleveland Engineering Society, organized in 1891 and now comprising a membership of approximately a thousand, and known throughout the country as one of the most active and influential local organizations of engineers. The national societies of Civil Engineers, Electrical Engineers and Automotive Engineers all have organized groups in Cleveland, so that opportunities for coöperation and coördination of activities are manifold.

Many of the officers and prominent members of the Cleveland Engineering Society are also included in our own membership, notably R. I. Clegg, Prof. F. H. Vose, Col. E. H. Whitlock, F. L. Sessions, F. W. Ballard, A. H. Bates, H. C. Hale, A. G. McKee, and J. H. Stratton. In addition to the liaison members, there are C. E. Drayer, George S. Black and W. O. Henderer of the C. E. S.; and Ambrose Swasey, Worcester R. Warner, S. T. Wellman (past officers of the Society), G. E. Merryweather and R. H. Danforth. Upon the abilities of these gentlemen we may count to realize to the fullest extent the enthusiasm in coöperative service for the greatest good.

It is hoped that papers presented at the proposed joint meetings in Cleveland may be published simultaneously in the *Journal* of the Cleveland Engineering Society and our own Journal, with mutual benefit. This *Journal* is a noteworthy feature of the local organization, having achieved wide repute in the field of technical periodicals.

The Cleveland spirit portends a growing enthusiasm in other localities, as the Society is intensely interested in spreading the movement to establish Sections which shall take an active part in the work of the local organizations in their districts.

New Officers of Sections

The following members of Executive Committees for the fiscal year 1918-1919 have been recorded by the Committee on Local Sections:

Atlanta: Robert Gregg, Chairman; William J. Neville, Secretary; H. J. Hinchey, C. P. Poole, Earl F. Scott.

Baltimore: A. E. Walden, Chairman; William L. De Baufre, Vice-Chairman; A. G. Christie, Secretary-Treasurer; W. W. Varney, J. C. Smallwood.

Birmingham: W. P. Caine, Chairman; Paul Wright, Vice-Chairman, James W. Moore, Secretary; H. M. Gassman, W. Lee Roueche.

Boston: W. G. Starkweather, Chairman; Elmer Smith, Secretary; A. C. Ashton, Treasurer; W. W. Crosby, George P. Aborn, Edward M. Jennings.

Buffalo: H. B. Alverson, Chairman; H. P. Parrock, Vice-Chairman; W. W. Boyd, Secretary; F. W. Bailey, Kester Barr.

Chicago: C. E. Lord, Chairman; P. A. Poppenhusen, Vice-Chairman; A. L. Rice, Secretary; Robert Quayle, J. J. Merrill.

Cincinnati: George W. Galbraith, Chairman; E. A. Muller, Vice-Chairman; J. T. Faig, Secretary-Treasurer; A. L. Jenkins, H. M. Norris.

Connecticut: To be announced.

Bridgeport Branch: E. L. Fletcher, Chairman; Arthur Brewer, Vice-Chairman; J. C. Kingsbury, Treasurer; C. F. MacGill, Secretary; J. Coulter, H. E. Wells.

Hartford Branch: Charles S. Blake, Chairman; Frank E. Howard, Vice-Chairman; M. D. Church, Secretary-Treasurer; C. L. Grohmann, B. M. V. Hanson, W. H. Honiss, S. F. Jeter, H. P. Maxim, C. H. Veeder.

Meriden Branch: C. K. Decherd, Chairman; C. N. Flagg, Jr., Secretary-Treasurer; F. L. Rowntree, J. A. Hutchinson, F. L. Wood.

New Haven Branch: J. A. Norcross, Chairman; E. H. Lockwood, Secretary; S. H. Barnum 2d, A. C. Jewett, F. L. Mackintosh, E. Pugsley.

Waterbury Branch: To be announced.

Detroit: E. C. Fisher, Chairman; E. J. Burdick, Vice-Chairman; F. H. Mason, Secretary-Treasurer; J. C. McCabe, E. J. Frost.

Erie: M. W. Sherwood, Chairman; C. M. Spalding, Vice-Chairman; R. Conrader, Treasurer; J. St. Lawrence, Secretary.

Indianapolis: L. W. Wallace, Chairman; W. A. Hanley, Vice-Chairman; B. G. Mering, Treasurer; Charles Brossman, Secretary; Gilbert A. Young, F. C. Wagner.

Los Angeles: Charles H. McGwire, Chairman; T. J. Royer, Secretary; Charles Burnham, Fred J. Fischer, J. A. Wintroath.

Milwaukee: W. M. White, Chairman; F. H. Dorner, Secretary; L. H. Strothman, W. Hutchens, M. A. Beck.

Minnesota: J. A. Teach, Chairman; R. B. Whitacre, Vice-Chairman; Ray Mayhew, Secretary-Treasurer; H. LeRoy Brink, J. V. Martenis.

New Orleans: H. L. Hutson, Chairman; E. W. Carr, Jr., Secretary-Treasurer; R. T. Burwell, W. E. Moses, J. S. Barelli.

New York: W. W. Macon, Chairman; H. D. Egbert, Secretary; S. M. Marshall, A. J. Baldwin, G. K. Parsons, W. C. Brinton.

Ontario: R. W. Angus, Chairman; C. B. Hamilton, Secretary; James Milne, J. H. Billings, G. V. Ahara.

Philadelphia: C. N. Lauer, Chairman; J. P. Mudd, Secretary; H. B. Taylor, L. F. Moody, W. B. Murphy, L. H. Kenney.

St. Louis: Lewis Gustafson, Chairman; J. P. Morrison, Secretary; George B. Evans, H. R. Setz, R. L. Radcliffe.

San Francisco: E. C. Jones, Chairman; Elgin Stoddard, Vice-Chairman; George L. Hurst, Secretary; H. S. Markey, J. H. Hopps.

Worcester: E. C. Mayo, Chairman; George N. Jeppson, Albert W. Darling, H. P. Fairfield, George E. Williamson, Frederick Fosdick.

BIRMINGHAM

September 9. An organization and business meeting was held in the Tutwiler Hotel. An open meeting for the latter part of October was decided upon.

JAMES W. MOORE,
Corresponding Secretary.

CHICAGO

A joint meeting of the Chicago Section of the A.I.E.E. and the War Committee of Technical Societies of Chicago was held on September 23. Col. P. Junkersfeld, Mem. Am. Soc. M. E., addressed the meeting on the subject of Emergency Conservation for the War Department in the U. S. The lecture was fully illustrated.

Joseph Harrington, Mem. Am. Soc. M. E., Fuel Administrative Engineer for the State of Illinois, and Dr. H. M. Nichols, Mem. Am. Soc. M. E., secretary of the Chicago Section of the A.S.M.E., spoke at the dinner given to Mr. C. E. Drayer, the new secretary of the American Association of Engineers, at the City Club on September 4.

ARTHUR L. RICE,
Corresponding Secretary.

DETROIT

The opening meeting of the season of the Detroit Engineering Society was held on September 6. H. H. Esselstyn, Mem. Am. Soc. M. E., addressed the meeting on the Hog Island Shipyard.

September 20. The Detroit Engineering Society held a meeting in the Detroit Board of Commerce, which was addressed by Professor Henry S. Jacoby, on the subject of Recent Progress in Bridge Construction.

F. H. MASON,
Corresponding Secretary.

CONNECTICUT

Bridgeport Branch

September 9. Through the courtesy of the Bridgeport Chamber of Commerce all members of the Bridgeport Branch were invited to a luncheon at the Stratfield Hotel, where a talk was given by Charles A. Otis, Chief of the Section on Resources and Conversion, War Industries Board, the subject being Industry and the War.

E. L. FLETCHER,
Chairman.

MILWAUKEE

September 11. The Engineers' Society of Milwaukee held a meeting in the City Club, at which E. R. Shepard, Associate Electrical Engineer of the United States Bureau of Standards, gave an illustrated talk on The Work of the Bureau of Standards, With Special Reference to Local Electrolysis Surveys. The meeting was preceded by a subscription dinner at the Club.

FRED H. DORNER,
Secretary, Engineers' Society of Milwaukee.

MINNESOTA

September 3. An organization meeting was held at the Midway Branch of the St. Paul Association of Commerce. Arrangements have been made to hold regular meetings in the clubrooms the first Monday of each month.

RAY MAYHEW,
Corresponding Secretary.

NEW YORK

September 17. Marcel Knecht, member of the French High Commission in the United States, addressed a meeting at the Engineering Societies' Building, to which members of the other national societies were specially invited. The subject of the address was The Supreme Effort of the French War Industries—Franco-American Industrial Coöperation During and After the War. Brigadier-General L. B. Kenyon, of the British War Mission, recently returned from a trip to the front, told of his experiences, including his observations of salvaging work and machine and repair shops. He discussed particularly the necessity, even yet not thoroughly appreciated, for precision work in manufacturing ordnance.

H. D. EGBERT,
Corresponding Secretary.

PHILADELPHIA

August 14. An organization meeting was held in the Engineers' Club, at which meetings were planned for each month, through May. The Section has also appointed several sub-committees on research, membership, public relations, organization, papers, meetings and boundary of the territory to comprise the Section.

JOHN P. MUDD,
Corresponding Secretary.

SAN FRANCISCO

A joint council of the engineering societies of San Francisco, including the A.S.C.E., the A.I.E.E., the A.S.M.E., the A.I.M.E. and A.C.S., has been organized with C. D. Marx as chairman, E. C. Jones and E. C. Hutchinson, vice-chairmen, N. A. Bowers, secretary, and E. O. Shrave, assistant secretary.

The organization is the outcome of several meetings at which plans for more effective coöperation between societies have been worked out. Some of the expected changes are a closer touch among the members of the several associations, putting the several employment bureaus together in one central office, holding joint meetings to discuss subjects of common interest, coöperating in mailing notices for the sake of economy and consolidating headquarters at the Engineers' Club.

The first act of the joint council was the decision to urge upon the Governor of California the appointment of an engineer as member of the State Railroad Commission, which would "be regarded by the state as indicating a wish to place the public service on the highest plane of efficiency and would be creditable both to the appointing power and to the engineering profession."

GEORGE L. HURST,
Corresponding Secretary.

NECROLOGY

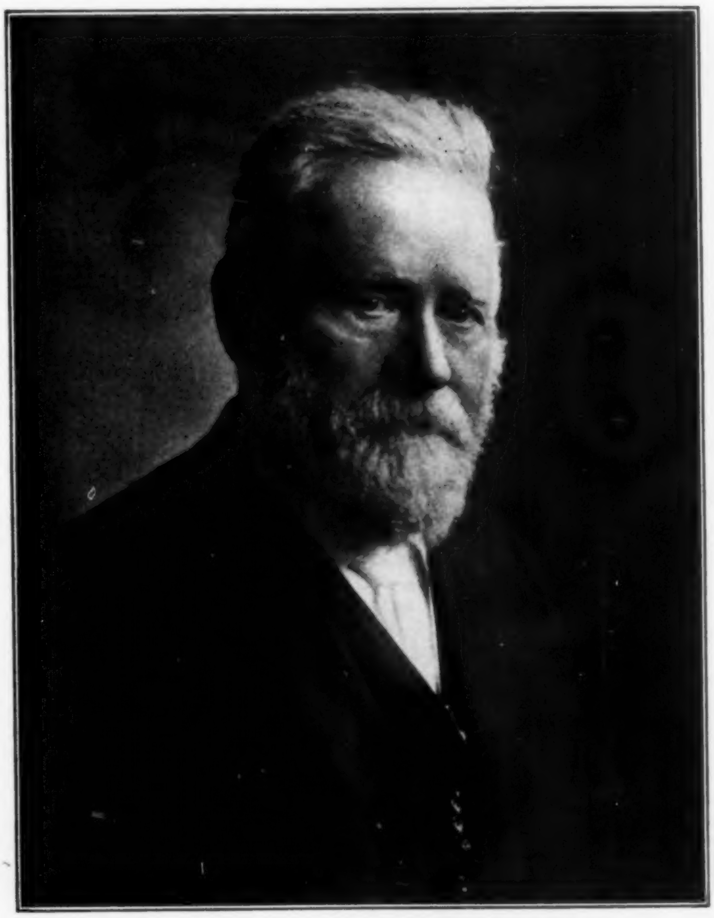
GEORGE WILLIAM DICKIE.

A Tribute by C. E. Grunsky[1]

Those who knew Mr. George W. Dickie mourn with his family. His death has removed from the engineering profession a man of rare attainments and attractive personality whose achievements in his life work of shipbuilding and whose writings on related subjects have given him an international reputation.

When in the Spanish-American war the *Oregon* of the United States Navy made that famous dash around South America from Pacific Coast waters to the Caribbean Sea, he became known in every household of this country as the "Builder of the *Oregon*."

He was called to his final rest on August 17, without warning and while still remarkably vigorous in mind and body and actively engaged in the service of the United States as Chief Inspector at the Moore and Scott Shipbuilding Yards, Oakland, California.



George W. Dickie

Having known Mr. Dickie for over thirty years and being deeply appreciative of his human qualities, I may be permitted a few words relating to his character and his professional standing without attempting a complete review of his achievements. No one ever came into close contact with Mr. Dickie whether socially, professionally, or in business without profiting by such contact. His personality was an inspiration. Always kindly and helpful and absolutely fair in his dealings with his fellow-men, he could claim the confidence, respect and esteem alike of those whose industrial affairs he directed and those who worked under him. This varied and long experience and his contact with affairs and with men of prominence from all parts of the world and a habit of close observation coupled with a retentive mind and a happy faculty of expression made Mr. Dickie a most charming companion and an entertaining writer. As related by him with a flavor of Scotch humor, the simple story of how as a boy upon the suggestion of his schoolmaster, who spent much time on scientific work, he acquired the necessary lenses and built himself a telescope to view a comet then in the sky, and how at a penny a look he turned its construction to financial profit, is not alone a delightful reminiscence but a forecast of his later connection with the installation of the great Lick telescope on Mt. Hamilton, for which he designed and built the dome in which it is housed.

Mr. Dickie was born in Arboath, Scotland, on July 17, 1844. He came to the United States with his parents in 1869 and in the same year reached San Francisco. Very soon after his arrival here he had an opportunity of showing his confidence in his ability to do well any problem of mechanical construction that was presented. Answering an advertisement for some one skilled in the construction of a gas plant, he was employed to erect one at North Beach. By following the usual practice of benefiting by the experience of others as related in professional papers and particularly by reference to the details of a gas plant recently completed in an English city and well described in a Scotch journal, the work was carried to successful completion.

Soon thereafter a mechanical engineer to design marine engines was wanted—possibly at the Risdon Iron Works, San Francisco, but the place does not matter—and Mr. Dickie presented himself. "You will not do," he was told, "we need a mechanical engineer and you are a gas engineer." Thereupon he confessed that his attainments were all along the lines of mechanical engineering, he having served his apprenticeship in a railroad engineering shop in Scotland with special attention to locomotive construction. He was thereupon or soon after employed at the Risdon Iron Works where his work took a wide range. [He designed the first successful triple-expansion engine ever built in the United States, and within a few years had made himself famous by designing the first Scotch marine boiler on the Pacific Coast and also the first successful compound steam engine. Several of the latter are still in operation, notably those on the old steamers *Santa Cruz* and *Gypsy*.] On one occasion he secured for his firm a large contract for mining machinery, making a proposition which was accepted as against another proposal by Mr. Irving M. Scott, of the Union Iron Works. This kind of successful competition was not to Mr. Scott's liking and resulted in his making an offer to Mr. Dickie, which was accepted. He thus became a member of the staff of a concern in which he had ample opportunity to apply his constructive genius. He was manager of the Union Iron Works from 1883 to 1905 [and during that period designed many privately owned ships, in addition to the following vessels for the Government: Battleships *Oregon*, *Wisconsin* and *Ohio*; the cruiser *Olympia*, later the flagship of Admiral Dewey; the cruisers *South Dakota*, *San Diego*, *Charleston* and *Milwaukee*, the gunboat *Wheeling* and destroyers *Paul Jones*, *Preble* and *Perry*.]

As a narrator of his personal experiences he was unique. He knew how to present them in a humorous vein and with a lesson nicely turned. And he was always ready, when opportunity was presented, to let others have the benefit of this fund of experiences which seemed inexhaustible. How effectively he could make his point appears from the following which happens to be before me. After returning from the Columbian Exposition at Chicago in 1893, he told the Technical Society of the Pacific Coast of his impressions and in the course of his remarks, to drive home the fact that local conditions must be duly weighed, he related the following occurrence:

"One day at the engineering congress in discussing a paper on river-steamboat construction I was endeavoring to point out the advantage of compounding stern-wheel engines, recommending tandem compounds on each side, either condensing or non-condensing, when the author of the paper remarked that first cost was the most important consideration in the construction of a western river steamboat, efficiency or durability being of secondary importance. 'But,' said I, 'the everyday expense of running must

[1] Mem.Am.Soc.C.E.; President, American Engineering Corporatiton, San Francisco, Cal. [Certain slight additions, in brackets, have been made to Mr. Grunsky's sixth paragraph.—Editor.]

be an important matter especially where transportation is effected so cheaply.' 'Why,' said the author of the paper, 'I am afraid that the gentleman from the Pacific Coast has had but a small experience with western river practice. As an example of economy let me give you an instance of a freight stern-wheeler in my district that made her daily runs for the last season of eight months on a total expense of $2.25 for fuel, and this expense was caused by the carelessness of the crew one night in not securing wood enough for the next day's run, necessitating the captain's buying enough to last until dark, as his method of taking on fuel would not work in daylight. In this case what would be the advantage of compounding?'"

That Mr. Dickie had an eye to the esthetic even in the design of the engine or other machinery, can hardly be better expressed than in his own words:

"I am often told that the useful only should be retained in any design. That is true, but who can say what is useful? Your best poet says:

'Nothing useless is or low,
Each thing in its place is best;
And what seems but idle show
Strengthens and supports the rest.'"

And then, after referring to several illustrations, he asks the question: "In regard to our other surroundings, we are not satisfied with the bare necessities of existence, and why should we be so in mechanics?"

And so we find, too, that Mr. Dickie was a great lover of books and took much pleasure in collecting rare volumes. It was quite pathetic to hear him tell how his valued collection was destroyed in the San Francisco earthquake and fire of 1906. At that time Mr. Dickie was in the East supervising the construction of ships that were being built from his designs. The collection of rare books had been boxed and deposited for safe keeping at Mr. Dickie's office in San Francisco, where they were reached by the fire and destroyed. Had they been left at the Dickie home in San Mateo, they would have been preserved. A year later there came from England an agent of a dealer in rare books commissioned to purchase from Mr. Dickie certain rare volumes which it was known were in his collection. He was prepared to pay some thousands of dollars, and, like Mr. Dickie, was distressed when he learned that the trade could not be made because the books no longer existed.

Mr. Dickie wrote many papers bearing upon marine architecture and engineering, and also on matters relating to the American merchant marine. He was recognized as an authority on such matters and was widely quoted. He was thoroughly imbued with American ideals and was ever ready to serve this country to the limit of his ability. Immediately on the outbreak of the war he offered his services to the U. S. Government. His fertile brain was active and he sent on a number of propositions dealing with the protection of allied shipping against attacks by submarines. He was appointed chief inspector for the Government at the Moore and Scott Shipbuilding Works as already stated, and despite his 74 years was rendering most efficient service when the last call came.

He possessed in a high degree the best character traits of the Scotchman. An idea of his probity and fairness to his fellowmen will appear from the following circumstance related to the writer some months ago. Mr. Dickie had some time in the seventies loaned a few hundred dollars to a stranded Canadian who gave his note for the loan and left as a pledge certain shares of stock of no market value in mines located on the Comstock Lode. Neither interest nor capital were repaid. The note outlawed. Meanwhile the Comstock properties came into prominence, the value of stock was soaring, and one day it occurred to Mr. Dickie to take the stock which he held to the Nevada Bank to ascertain whether it had any value. When he was told that it was worth $75,000 he was so taken by surprise that his knees came near giving away and he with difficulty withdrew from the bank. The stock was at once sent to the former owner, from whom, despite a fair offer, Mr. Dickie would accept nothing but a repayment of the loan and interest.

Mr. Dickie has been a useful man in the community. He had the esteem and love of those who knew him. He has left a place which none other can fill.

Mr. Dickie became a member of our Society in 1892. From 1895 to 1898 he held the office of Manager of the Society. He was also a life member of the Technical Society of the Pacific Coast, and a member of the California Academy of Sciences and the American Society of Naval Engineers.

ADOLPH FABER DU FAUR

Adolph Faber du Faur was born on March 27, 1826, in Wasseralfingen, Württemberg. After his preparatory education he entered the University of Tübingen, and upon graduation was employed for a year in Belgium at the Cockerill works. He was then appointed as assistant to his father, Wilhelm von Faber du Faur, who was permanent director of the government iron works in Wasseralfingen, and under whose management they became world-known.

In January 1851 Mr. Faber du Faur resigned from his position in Wasseralfingen and came to the United States, where he was first employed in Trenton, N. J. His next position was with the Balbach Smelting & Refining Co., Newark, and a little later he was connected with the New Jersey Zinc Co.

In 1857 he went to Washington and was there engaged until 1861 on the United States Capitol extension, the Post Office extension and the Washington Aqueduct, under Captains M. C. Meigs and V. B. Franklin. In 1861 he was called upon to undertake engineering work for the Government and had charge of the construction of Fort Stanton. During the Civil War he was under General Meigs in the Quartermaster Department and was appointed special agent of the Quartermaster Department for steam transportation. In 1867 he resigned from the service and went to Richmond, Va., there to take charge of the Westham Furnace. In 1868 he returned to New York and opened an office as mining and consulting engineer and expert in patent causes. He was actively engaged in this work up to within a few years ago, when age compelled his retirement. He died on August 17, 1918. He became a life member of the Society in 1880.

ALBERT BLAUVELT

Albert Blauvelt was born in Philadelphia, Pa., on June 7, 1862. After graduation from the Kingston Academy, Kingston, N. Y., he served an apprenticeship in the drafting room of F. L. Roberts, New York. From 1879 to 1883 he was connected with the McEntee Locomotive Works, Rondout, N. Y., and with the West Point Foundry. The following year he was in the employ of the Lidgerwood Co., Brooklyn, N. Y. He was next associated as designer and expert draftsman with the Fall Steam Pump Co., the Cold Springs, N. Y., Rifle Works, and the Baldwin Locomotive Works, respectively. From 1890 to 1894 he was with the Edison Electric Co., Orange, N. J., and then with the American Oil Co., as engineer in the insurance department. In 1894 he entered the employ of the Western Factory Insurance Association, Chicago, Ill., and at the time of his death, January 4, 1918, held the position of associate manager.

Mr. Blauvelt was among the pioneers to bring into prominence the profession of fire-protection engineering and in that profession he was recognized as an authority. He became a member of our Society in 1896.

JOHN J. MULLANEY

John J. Mullaney was born in Ireland in 1864. He was brought to this country when a child and was educated in the schools of New York City, later attending Cooper Union. His apprenticeship was spent with the Delamater Iron Works, New York, from 1880 to 1884. The next three years he was employed as a machinist and in 1888 he became superintendent of the tool and manufacturing departments of the Columbia Typewriter Co. and the following year was associated with the Smith Premier Typewriter Co. About 1890 he became associated with the Brosius Sewing Machine Co. as superintendent, resigning in 1893 to take a similar position with the Garvin Machine Co. Later he was president of the Ideal Opening Die Co., New York. At the time of his death Mr. Mullaney had consulting offices in New York.

He became a member of the Society in 1901. He died suddenly in the early part of June in Redbank, Cal.

HOWARD L. COBURN

Howard L. Coburn was born in Patten, Me., in 1867. He was graduated in 1887 from the Massachusetts Institute of Technology

and up to the time of his death had been associated in its development.

Mr. Coburn designed some of the largest cotton mills and power plants in New England and until 1904 devoted himself to that phase of his profession. About that time he became associated with the Ambursen Construction Co., New York, as chief engineer and director, and in that capacity began the building of dams.

One of the most important of his works was the construction of the Guayabal Dam for the United States Irrigation Service in Porto Rico. He also put the Bassan Dam across the Bow River in Alberta for the Canadian Pacific Railway, and the Jordan River Dam on Vancouver Island, B. C. In this country he built the Shoshone and Laprelle Dams in Wyoming, the dam at Akron, Ohio, and the Pittsfield Dam, located at Pittsfield, Mass.

In addition to this work he was associated as consulting engineer with Henry L. Doherty & Co., E. W. Clarke & Co. and H. M. Byllesby & Co.

Mr. Coburn was a member of the American Society of Civil Engineers, the Engineers' clubs of New York and Boston and of the Technology Club. He became a member of the Society in 1901. He died on June 19, 1918.

WILLIAM KENT

William Kent, eminent consulting engineer, author, educator, editor, and former manager and vice-president of the Society, died at his summer home in Gananoque, Ont., on September 18.

Professor Kent was born in Philadelphia in 1851 and was educated at the Central High School of that city, and at Stevens Institute of Technology, from which latter he was graduated in 1876. From 1877 to 1879 he was editor of the *American Manufacturer and Iron World*, of Pittsburgh, and from 1879 to 1890 he served as mechanical engineer with several manufacturing concerns. From 1895 to 1903 he was associate editor of *Engineering News* and for the following five years was dean of the L. C. Smith College of Applied Science, of Syracuse University. From 1910 to 1914 he was editor of *Industrial Engineering*. While practicing from an early day as consulting engineer, he was nevertheless most widely known in the engineering world as the author of The Mechanical Engineers' Pocket-Book, of which nine editions, aggregating more than 100,000 copies, have been printed.

A more extended account of Professor Kent's professional career will appear in the next issue of The Journal.

ROLL OF HONOR

Bergstrom, Harry E., First Lieutenant, Co. B, 69th Regiment Engineers, Fort Myers, Va.

Beyer, O. S., Captain, Chemical Warfare Service, U. S. Army, assigned to the American University Experiment Station, Washington, D. C.

Bissell, Albert W., Artillery Training School for Officers, Camp Zachary Taylor, Ky.

Bohnstengel, Walter, 109th Mobile Ordnance Repair Shop, Camp Cody, N. M.

Boynton, John E., Captain, Engineers, U. S. Army, assigned to Camp Humphreys, Va.

Brewer, Allen F., Chief Machinist's Mate, Engineer Officers' Material School, U. S. Naval Reserve Force.

Buck, Irwin, Captain, Ordnance Department, U. S. Army, assigned to Willys-Overland Co., Toledo, O.

Carroll, E. J., Lieutenant, Bureau of Steam Engineering, Navy Department.

Cary, James W., Private, 48th Co., Coast Artillery Corps, U. S. Army, San Francisco, Cal.

Case, George S., Major, Chemical Warfare Section, U. S. Army.

Cathcart, William L., Lieutenant Commander, U. S. Navy, assigned to special duty in Bureau of Steam Engineering, Washington, D. C.

Conrad, H. V., Captain, Inspection Division, Ordnance Department, U. S. Army.

Dorrance, George W., Second Lieutenant, Air Service, U. S. Army.

Evans, Melvin J., Second Lieutenant, Ordnance Department, U. S. Army, assigned to Savanna Proving Ground, Savanna, Ill.

Everitt, I. D., Lieutenant, Ordnance Department, U. S. Army, assigned to Aberdeen Proving Grounds, Md.

Geddis, Robert H., Corporal, 16th Co., 152d Depot Brigade, Camp Upton, N. Y.

Hanson, John J., First Lieutenant, Ordnance Department, U. S. Army.

Haselton, Philip H., Second Lieutenant, Ordnance Department, U. S. Army, assigned to Aberdeen Proving Grounds, Md.

Hill, George F., Captain, Chemical Warfare Section, Ordnance Department, U. S. Army.

Holden, Edward A., Chief Machinist's Mate, U. S. Steam Engineering School, Pelham Bay Naval Training Station, 2nd Co., 6th Regiment.

Houston, H. A., Captain, Engineers, U. S. Army.

Keller, John O., Second Lieutenant, Ordnance Department, U. S. Army; assigned as Materiel Instructor, Ordnance Supply School, Camp Hancock, Ga.

Kerr, Charles P., First Lieutenant, Air Service, U. S. Army, Technical Section, American Expeditionary Forces, France.

Kniese, First-class private, Engineering Section, Ordnance Department, U. S. Army.

Lynd, Roy E., Captain, Ordnance Department, U. S. Army, assigned to the Tredegar Co., Richmond, Va.

Malcome, George H., Captain, Chemical Warfare Service, Gas Defense Division, U. S. Army.

Marshall, K. I., First Lieutenant, Chemical Warfare Service, U. S. Army, American Expeditionary Forces, France.

Marshall, W. A., Private, Machine Gun Company Detached Service; American Wing, British G. H. Q., Machine Gun School, B. E. F., France.

May, J. T. L., First Lieutenant, Chemical Warfare Service, U. S. Army, assigned to Fourth Battalion Headquarters, Edgewood Arsenal, Edgewood, Md.

Miles, Dale S., Private, First class, Quartermaster Mechanical Repair Shop, Fort Sam Houston, Tex.

Penney, R. L., Major, Ordnance Department, U. S. Army; assigned to Rock Island Arsenal, Rock Island, Ill.

Prozan, Moses, Private, Mechanical Resources and Development Division, Chemical Warfare Section, U. S. Army, American University, Washington, D. C.

Reckerdres, Henry, Ensign, U. S. Navy, Submarine Service.

Reed, Melbourne O., Ensign, U. S. Navy, assigned to U. S. Naval Training Camp, 10th Regiment, Pelham Bay Park, N. Y.

Richmond, Julian, Lieutenant, U. S. Naval Reserve Corps, Paris, France.

Royer, Earl B., Private, Medical Detachment, 6th U. S. Cavalry, American Expeditionary Forces, France.

Ruddy, William, First Lieutenant, Inspection Division, Ordnance Department, U. S. Army.

Skinner, James D., Captain, Ordnance Department, U. S. Army.

Smith, Harry R., Candidate, Field Artillery Officers' Training Camp, Camp Zachary Taylor, Ky.

Stanton, Robert B., Jr., First Lieutenant, Engineers, U. S. Army.

Stockmann, E. B., Ensign, U. S. Naval Reserve Submarine Unit, 10th Regiment, U. S. Naval Reserve Force, Pelham Bay Naval Camp, New York.

Tait, Godfrey M. S., Captain, Chemical Warfare Service, U. S. Army.

Turley, Charles L., Lieutenant, 21st Engineers, U. S. Army.

Vincent, J. G., Lieutenant-Colonel, Air Service, U. S. Army; Airplane Engineering Department, Bureau of Aircraft Production.

Wadsworth, G. R., Major, Signal Corps, U. S. Army, Chief Engineer, Naval Aircraft Factory, Navy Yard, Philadelphia, Pa.

Watkins, Roy A., Ensign, U. S. Naval Reserve Force, Aviation Department, assigned to Bureau of Steam Engineering, Division of Aeronautics, Washington, D. C.

Yates, Sheldon S., Candidate, Field Artillery Officers' Training Camp, Camp Zachary Taylor, Ky.

Young, Charles M., Ordnance Training School, Fort Slocum, New York.

Fourth Liberty Loan

THE people of the United States are asked to subscribe for $6,000,000,000 of bonds at 4¼ per cent interest, which will mature on October 15, 1938, unless the Government exercises its right to redeem the issue on or after October 15, 1933. Bonds will be dated October 24, 1918, and the first interest coupon for 173 days will be payable April 15, 1919. Interest dates thereafter will be October 15 and April 15.

Denominations of bonds: Coupon and registered bonds will be issued in amounts of $50, $100, $500, $1,000, $5,000, $10,000; and registered bonds in amounts of $50,000 and $100,000.

The interest on $30,000 of bonds of the Fourth Liberty Loan is exempt, until two years after the termination of the war, from surtaxes and excess profits and war-profits taxes. The bonds are also permanently exempt from all other federal, state, and municipal taxation, except estate and inheritance taxes.

Initial payment will be 10 per cent payable with the subscription and subsequent payments will be as follows: 20 per cent on November 21, 1918; 20 per cent on December 19, 1918; 20 per cent on January 16, 1919; 30 per cent on January 30, 1919. Payment may be made in full at time of subscription or on any subsequent installment date. *The campaign started on September 28 and ends on October 19.*

Comparative Data of Three Previous War Loans

First Liberty Loan, May 5 to June 15, 1917: subscription invited, $2,000,000,000; amount subscribed, $3,716,322,450; allotment, $2,000,000,000. Interest, 3½ per cent.

Second Liberty Loan, October 1 to October 27, 1917: subscription invited, $3,000,000,000; amount subscribed, $4,617,532,300; allotment, $3,808,766,150. Interest, 4 per cent.

Third Liberty Loan, April 6 to May 4, 1918: subscription invited, $3,000,000,000; amount subscribed, $4,176,517,550; allotment, full amount subscribed. Interest, 4¼ per cent.

LIBRARY NOTES AND BOOK REVIEWS

REVIEWS of books of special importance to mechanical engineers by members of the Society and those particularly qualified, brief descriptive notes of accessions to the Library of the United Engineering Society, items of interest relating to the Library's activities, etc.

Bookkeeping and Cost Accounting for Factories. By William Kent, M.E., Sc.D., Mem.Am.Soc.M.E. John Wiley & Sons, Inc., New York, 1918. Cloth, 8¼ x 10 in., 261 pp., profusely illustrated with forms. $4 net.

This recently written work differs materially from any other on the subject that has been called to my attention.

The aim of the author has been to present his subject to engineers, manufacturers and students in a manner that would appeal to practical men and at the same time combine the theoretical principles of accounting in a way to be easily understood and readily followed by those far enough advanced in a knowledge of factory management.

The book is peculiarly well fitted to serve as a textbook for the management and accounting departments of large manufacturing companies, especially those engaged in metal industries, as the problems of bookkeeping and cost finding have been analytically handled, due consideration being given to modern methods and the developments of systems that have stood the acid test and have become practically standard methods in general use wherever their special merit has proved them especially applicable to certain classes of business.

Mr. Kent has succeeded in working out many clearly detailed examples descriptive as to the accounting and cost methods that should be followed, all of which represent practical methods that have been successfully used and can be easily modified and applied to varying manufacturing conditions and requirements.

The chapters on Cost Finding Methods; Distribution of Burden; Depreciation, Inventory Valuation and Appraisals; Charting of Statistics; Problems and Difficulties *re* Standard Costs, are very well written, and the mass of information culled from many reliable sources, combined with Mr. Kent's well-known analytical method of treating subjects of this kind, makes the work one which places before the reader the most concise and up-to-date treatment of the subject that has yet been published in a single volume.

It is this feature of the new work that will appeal to the constructive reader, as it enables him to grasp clearly in a minimum time the various phases of any problem in bookkeeping and cost accounting in which he may be interested. It is essentially a work of reference and will be consulted more often than the usual work of this character that has been published to develop one theory and leaves the reader to wander through many other publications before he can secure a comprehensive grasp of the subject.

To the factory accountant anxious to improve his methods of accounting, the chapters on Factory Accounting, Cost Accounting, Modern Accounting Systems for Steel Works, etc., furnish a fund of knowledge that is readily understood and capable of easy modifications to meet varying conditions.

On the whole, I feel that Mr. Kent has succeeded admirably in gathering together the best ideas and methods in use today, supplementing these by his own views, clearly expressed and easily followed, and has produced a book that more nearly represents a standard textbook on factory bookkeeping and cost accounting than any other published to date.

Albert Walton.

Aeroplane Construction and Operation. Including Notes on Aeroplane Design and Aerodynamic Calculation, Materials, Etc. A Comprehensive Illustrated Manual of Instruction for Aeroplane Constructors, Aviators, Aero-Mechanics, Flight Officers and Students. Adapted Either for Schools or Home Study. By John B. Rathbun. Stanton and Van Vliet Co., Chicago, 1918. Cloth, 5 x 8 in., 426 pp., illus., pl., charts, diag., tables. $2.

The author has attempted to produce a book standing between the popular descriptive work and the mathematical engineering treatise, which will meet the needs of aviators and airplane builders. The volume covers the subject concisely and simply with the use of only elementary mathematics.

Allen's Commercial Organic Analysis. A Treatise on The Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products Employed in the Arts, Manufactures, Medicines, etc., with Concise Methods for the Detection and Estimation of Their Impurities, Adulterations, and Products of Decomposition. Vol. IV. By the Editors and the following Contributors: M. Bennett Blackler, E. W. Lewis, T. Martin Lowry, Ernst J. Parry, Henry Leffmann, Charles H. Lawall. Fourth edition, entirely rewritten. Edited by W. A. Davis and Samuel S. Sadtler. P. Blakiston's Son & Co., Philadelphia (copyright 1911, reprinted 1917). Cloth, 6 x 9 in., 466 pp., tables. $5.

The subject has been divided between a number of authorities and much new matter has been included, so that the volume forms a convenient compendium of present knowledge on the subject.

Chemical Control of Gas Manufacture. Practical Instruction in Gas Works Chemistry for Superintendents, Foremen and Chemists. Part I. Practical Application. By W. M. Russell. Part II. Elementary Chemical Theory. By F. Wills. The Gas Age, New York, 1916. Cloth, 5 x 8 in., 152 pp., 47 illus., 1 pl., 18 tables. $1.50.

Devoted to a discussion of the methods for controlling gas-works processes by the use of chemistry, giving the most recent and reliable tests and analyses and explaining the methods used. Adapted to the requirements of the men in the smaller plants.

The Design of Aeroplanes. By Arthur W. Judge. Whittaker & Co., New York, 1917. Cloth, 6 x 9 in., 242 pp., 90 illus., 67 tables. $4.

This volume endeavors to fulfill the need for a compendium in which the principles underlying aeroplane design, from the standpoint of the mechanical engineer, are concisely presented and accompanied by the necessary data. A small amount of new matter has been inserted in this edition, typographical errors have been corrected and a chapter on fuselage design and construction added. Contains a bibliography.

Electrical Phenomena in Parallel Conductors. Vol. I. Elements of Transmission. By Frederick Eugene Pernot. First edition. John Wiley & Sons, Inc., New York, 1918. Cloth, 6 x 9 in., 332 pp., 82 illus., 35 tables. $4.

Gives the mathematical developments leading to solutions for a number of problems arising in connection with the transmission of electrical energy over metallic circuits. Deals with continuously alternating-current phenomena only and is intended to serve as an introduction to subsequent volumes deal-

ing with specialized forms of electrical transmission. There is an appendix containing formulae and tables.

Electrical Locking. By James Anderson. Simmons-Boardman Publishing Co., New York (copyright, 1918). 6 x 9 in., 219 pp., 210 illus. $2.

Describes in detail the various methods for the supplementary protection of a system of interlocking switches, the apparatus used, methods of wiring, etc. Portions of the book appeared in the *Railway Signal Engineer*.

A Handbook of Briquetting. By G. Franke, translated by Fred C. A. H. Lantsberry. Vol. II. Briquetting of Ores, Metallurgical Products, Metal Swarf and Similar Materials, Including Agglomeration. J. B. Lippincott Co., Philadelphia, 1918. Cloth, 6 x 9 in., 214 pp., 79 illus., 4 folded pl., 14 tables.

Describes the various materials briquetted, methods of briquetting and agglomeration, preparation of material, compression and subsequent treatment of briquets. A number of complete briquetting and agglomeration plants in Germany and Austria are shown in detail. Appendices to vols. 1 and 2 are included.

Handbook of Mathematics for Engineers. By Edward V. Huntington, with Tables of Weights and Measures by Louis A. Fischer. Reprint of Sections 1 and 2 of L. S. Marks's Mechanical Engineers' Handbook. First edition. McGraw-Hill Book Co., Inc., New York, 1918. Flexible cloth, 5 x 7 in., 191 pp., illustrated, tables.

Designed to supply in compact form, accurate statements of those facts and formulæ of pure mathematics which are most likely to be of use to the worker in applied mathematics.

How Wooden Ships Are Built. A Practical Treatise on Modern American Wooden Ship Construction with a Supplement on Laying Off Wooden Vessels. By H. Cole Estep. The Penton Publishing Co., Cleveland, 1918. Cloth, 9 x 12 in., 101 pp., 201 illus., 6 tables.

This book is a revised publication of a series of articles that appeared in *The Marine Review*. It deals with methods of construction rather than with ship design and is intended for shipbuilders rather than for naval architects. A supplement on methods of laying down wooden ships is included.

Hydraulic and Placer Mining. By Eugene B. Wilson. Third edition, thoroughly revised. John Wiley & Sons., Inc., New York, 1918. Cloth, 5 x 8 in., 425 pp., 95 illus., 1 pl., 20 tables. $3.

The third edition contains much additional information intended to bring the work up abreast of the latest improvements in this industry. The book is designed to appeal not only to those actually engaged in placer mining, but also to those who wish to get the latest ideas on the subject.

Municipal Housecleaning. The Methods and Experiences of American Cities in Collecting and Disposing of their Municipal Wastes—Ashes, Rubbish, Garbage, Manure, Sewage, and Street Refuse. By William Parr Capes and Jeanne Daniels Carpenter, with an introduction by Cornelius F. Buns. E. P. Dutton & Co., New York, 1918. Cloth, 6 x 10 in., 232 pp., 16 tables (2 folded). $6.

Designed to furnish the information needed by those who are interested in the problems of the collection, care and disposal of municipal wastes. Also takes up the need for more efficient management and for the development of revenue-producing by-products. Intended to help public officials in selecting and operating the system best adapted to local conditions, and also to serve as a guide to the layman who wishes to inform himself about the methods of municipal housecleaning.

Ports and Terminal Facilities. By Roy S. MacElwee. First edition. McGraw-Hill Book Co., Inc., New York, 1918. Cloth, 6 x 9 in., 315 pp., 118 illus., 1 folded map, 17 tables. $3.

Contents: The Nature of the Problem, The Relative Importance and Physical Characteristics of the World's Leading Ports, General Characteristics of a Well-Coordinated Seaport, Port Competition for Rail and Maritime Freight, The Harbor Belt Railway and Competition at the Terminals, Lighterage, Cartage, Drays and Motor Trucks, Piers, Wharves and Quays, Wharf Equipment, Cargo Transfer and Handling, Shed Equipment, The Warehouse, Standard Package or Specialized Freight, Bulk Freight, Inland Waterways and the Seaport, The Industrial Harbor and Upland Development, The Free Port as an Institution, The Processes By Which the Free Ports of Hamburg and Bremen Were Created, Bigliography.

A revision of the material used in a course of lectures at the School of Business, Columbia University. Discusses some of the engineering and economic factors which determine the success or failure of a port.

Standard Cotton Mill Practice and Equipment. With Classified Buyer's Index. Published Annually by The National Association of Cotton Manufacturers, Boston, 1918. Cloth, 6 x 9 in., 203 pp., illus., tables. $1.50.

An annual encyclopedia, containing economic trade and engineering data of interest to mill executives. Contains also a classified directory of manufacturers of cotton-mill supplies and equipment.

Steam Engines. A Thorough and Practical Presentation of Modern Steam Engine Practice. By Llewellyn V. Ludy. American Technical Society, Chicago, 1917. 6 x 8 in., 192 pp., 103 illus., 1 pl., 8 tables. $1.

Treats of the theory and construction of various types of steam engines, and of their purchase, operation and testing. A non-mathematical treatise intended for stationary engineers and particularly adapted for home study.

Storrs. A Handbook for the Use of Those Interested in the Construction of Short-Span Bridges. By John W. and Edward D. Storrs. Published by the authors, Concord, N. H., 1918. Flexible cloth, 4 x 7 in., 40 illus., 20 tables. $1.

A small pocketbook containing designs and methods of construction of small highway bridges, culverts, etc. Intended to assist men without engineering training in the construction of such structures.

Uniform Cost Accounting for Steel Furniture Industry. Compiled by Erich W. Kath. The National Association of Steel Furniture Manufacturers, Cleveland (copyright, 1918). Cloth, 5 x 8 in., 106 pp., 5 forms.

The methods of ascertaining costs presented are the result of careful investigation of the conditions in different organizations. The systems recommended are in accord with the best practices of accounting and can, with minor changes, be adapted to the needs of the various concerns.

Water Rights Determination. From an Engineering Standpoint. By Jay M. Whitham. First edition. John Wiley & Sons, Inc., New York, 1918. Cloth, 6 x 9 in., 204 pp., tables. $2.50.

Intended to assist an owner of an indefinite water right in determining the meaning of his right as expressed in horsepowers, and the number of cubic feet of water per second to which he is entitled. Gives citations from representative writings and presents many tests and power determinations used by the author. A bibliography is included.

PERSONALS

IN these columns are inserted items concerning members of the Society and their professional activities. Members are always interested in the doings of their fellow-members, and the Society welcomes notes from members and concerning members for insertion in this section. All communications of personal notes should be addressed to the Secretary, and items should be received by October 15 in order to appear in the November issue.

CHANGES OF POSITION

PHILIP D. WAGONER, president of the General Vehicle Company, Long Island City, N. Y., has assumed similar duties with the Elliott-Fisher Company, Harrisburg, Pa.

HENRIK GREGER has accepted a position as assistant engineer in the engineering section of the Division of Steel Ship Construction of the Emergency Fleet Corporation, Philadelphia, Pa. He was formerly affiliated with the Prescott Company, Menominee, Mich.

GEORGE S. WHEATLEY has assumed the duties of efficiency engineer, Midvale Steel and Ordnance Company, Coatesville, Pa. He was until recently secretary to the vice-president of the Midvale Steel Company, Philadelphia, Pa.

FRANK G. FROST, formerly general superintendent of the Houston Lighting and Power Company, Houston, Tex., has accepted the position of superintendent of power for the New Orleans Railway and Light Company, New Orleans, La. Both of these companies are subsidiaries of the American Cities Companies.

RALPH EARL, formerly associated with Morris Knowles, Inc., Pittsburgh, Pa., in the capacity of assistant engineer, has become connected with the Water Purification Board, Sewerage and Water Board, New Orleans, La.

LELAND G. KNAPP, until recently affiliated with the Harsh and Chapline Shoe Company, Milwaukee, Wis., as efficiency engineer, has entered the employ of the Wisconsin Motor and Manufacturing Company, of the same city.

JOHN B. WILKINSON has become identified with the Federal Dyestuff and Chemical Corporation, Kingsport, Tenn., in the capacity of superintendent of heat, light and power. He was formerly draftsman with the Nordberg Manufacturing Company, East Milwaukee, Wis.

E. T. SPIDY, formerly production engineer, Canadian Ingersoll-Rand Company, Sherbrooke, Canada, has accepted a similar position with the Canadian Pacific Railway Company, Angus Shops, Montreal, Canada.

DOUGLAS K. WARNER, efficiency engineer, New Departure Manufacturing Company, Burdett, N. Y., has become connected with the Sheffield Scientific School, Yale University, New Haven, Conn.

JILES W. HANEY has accepted the position of assistant professor of mechanical engineering, University of Nebraska, Lincoln, Neb. He was formerly affiliated with the experimental engineering department of Pennsylvania State College, State College, Pa.

GRANT E. FURBUSH has resigned his position as instructor in industrial engineering at Pennsylvania State College, State College, Pa., and has accepted the position of mechanical engineer with the Fafnir Bearing Company, New Britain, Conn.

E. J. HEINEN, formerly with the Strong and Scott Company, Minneapolis, Minn., is now efficiency engineer with the Minneapolis General Electric Company.

CHARLES J. SIMEON, formerly with the Curtiss Aeroplane Company, Buffalo, N. Y., has accepted the position of employment manager with the Morgan Construction Company, Worcester, Mass.

F. W. SHUMARD, equipment and production engineer at the Utica, N. Y., plant of the Savage Arms Corporation, has accepted a similar position in Washington, D. C., in the maintenance division of the Motor Transport Corps.

NORMAN G. HARDY has become affiliated with the old Hickory Powder Plant, Jacksonville, Tenn. He was formerly connected with the Arizona Copper Company, Clifton, Ariz., as superintendent of power.

HUGO R. PAUSIN has resigned his position as superintendent, E. W. Bliss Company, Brooklyn, N. Y., to take a position as production manager, Metropolitan Engineering Company, Brooklyn, N. Y., on a trench-warfare contract for the United States Government.

FRANCIS J. MCGRAIL, formerly foundry superintendent, Struthers-Wells Company, Tonawanda, N. Y., is now in the employ of the Walker Foundry Company, Erie, Pa., in the capacity of general superintendent.

GEORGE D. REYNOLDS has resigned his position as machine designer at Edgewood Arsenal, Baltimore, Md., to accept the position of works manager of the Quickwork Company, St. Marys, Ohio, manufacturers of rotary shears, sheet and plate metal working machinery, etc.

CONRAD H. RAPP, formerly associated with Hoggson Brothers, New York, as assistant manager, designing and engineering department, has assumed the duties of project manager, Bureau of Industrial Housing, officially the U. S. Housing Corporation.

HERBERT D. MOZEEN has severed his connection with the Syracuse Supply Company, Syracuse, N. Y., and has become identified with the Bureau of Aircraft Production, Dayton, Ohio.

FRANK L. GLYNN, formerly associated with the Curtiss Aeroplane and Motor Corporation, Buffalo, N. Y., has accepted the position of superintendent of the Training Department, Ordnance Department, Production Division, Philadelphia, Pa.

FRANK SAWFORD, until recently chief engineer, electrical and mechanical operations, Canadian Collieries, Union Bay, B. C., Canada, has become affiliated with the Taylor Engineering Company, Ltd., Vancouver, B. C., Canada.

ARTHUR B. COATES has resigned the position of instructor in mechanical engineering at the University of Idaho, Moscow, Idaho, and has become connected with the experimental engineering department of the Ford Motor Company, Detroit, Mich.

WALTER F. JAY has resigned his position as works manager of the Power Specialty Company, Dansville, N. Y., after an association of 13 years, to accept the position of production engineer, Production Division, War Department, Rochester District Ordnance office.

WALTER E. WOLLHEIM has severed his connection with the engineering department of the Nathan Manufacturing Company, Flushing, L. I., to assume the duties of president and mechanical engineer of the Alloy Foundry and Machine Corporation of New Rochelle, N. Y.

WILLIAM W. CONNER, formerly with the engineering department of the Eastman Kodak Company, Rochester, N. Y., has accepted a position as power superintendent at the Chrome, N. J., plant of the U. S. Metals Refining Company.

ARTHUR J. COLDWELL, formerly superintendent of the Coldwell Lawn Mower Company, Newburgh, N. Y., has assumed the position of production engineer, Ordnance Department, U. S. A., New York.

R. H. ROBINSON, until recently superintendent of the metal division of the Standard Aircraft Corporation, Elizabeth, N. J., has become associated with the Land Products Company, Whitestone, L. I., N. Y., manufacturers of aircraft propellers, in the capacity of production manager.

ALEXANDER VALLANCE has become connected with the shell department of the American Machine and Manufacturing Company, of Atlanta, Ga. He was formerly assistant professor of experimental engineering, Georgia School of Technology, Atlanta, Ga.

ALBERT P. LEONARD, assistant chief engineer, Honolulu Iron Works Company, New York, has become affiliated with the engineering division of the Bureau of Aircraft Production, Dayton, Ohio.

GILBERT R. HAIGH has taken up work in the U. S. Ordnance Department, as supervisor of production in the Saginaw, Mich. district. He was formerly connected with the Wilt Engineering Company, Detroit, Mich., in the capacity of production engineer.

ANNOUNCEMENTS

W. J. SCHLACKS, formerly general manager of McCord and Company, Chicago, Ill., announces that he has purchased the McCord locomotive lubricator and has incorporated the Locomotive Lubricator Company for the manufacture and sale of the Schlacks system of locomotive force-feed lubrication.

WILLIAM P. BIXBY has become affiliated with the Blaw-Know Company, Pittsburgh, Pa.

ELMO J. MILLER, consulting engineer, of Santiago, Cuba, has assumed the position of general manager, Compañie Azucarera Oriente, Xavier, Oriente, Cuba.

DAVID F. ATKINS has become associated with the Lord Electric and Lord Construction Companies, New York, in the capacity of mechanical engineer.

F. H. ROSENCRANTS has accepted the position of mechanical equipment inspector, American International Shipbuilding Corporation, Hog Island, Pa.

JOHN G. SCHABERT has been promoted to the position of assistant chief engineer of the Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn.

E. L. CONSOLIVER has been engaged in army training work since April 8, as chief instructor in the starting, lighting and ignition division in the University of Wisconsin Army School for Automobile Mechanics, organizing the work of this department. Since May, 1916, Professor Consoliver has been acting head of the mechanical engineering department, in the absence of B. G. Elliott, retaining, however, his connection with the University Extension Division. On July 1 his title was officially changed to assistant professor of mechanical engineering, University Extension Division, University of Wisconsin.

R. S. WILBUR has assumed the duties of assistant professor of mechanical engineering, Lafayette College, Easton, Pa.

DANIEL W. MILLER, of the Vacuum Oil Co., Minneapolis, Minn., has recently been made a special representative of the company, with offices at Chicago.

A. O. GUSTAFSON is employed as checker in the engineering department of the Liberty Ordnance Plant, American Can Company, Bridgeport, Conn.

GEORGE H. BERGE, formerly manager of Murphy Iron Works, Boston office, has succeeded the late M. C. Huyette, of the Buffalo office, and is now district manager for that territory.

EMPLOYMENT BULLETIN

THE SECRETARY considers it a special obligation and pleasant duty to make the office of the Society the medium for assisting members to secure positions, by putting them in touch with special opportunities for which their training and experience qualify them, and for helping any one desiring engineering services. The Society acts only as a clearing house in these matters.

GOVERNMENT POSITIONS

Stamps should be inclosed for transmittal of applications to advertisers; non-members should accompany applications with a letter of reference or introduction from a member; such reference letter will be filed with the Society records.

MECHANICAL ENGINEERS for Inspection Division of Ordnance Department; both younger and older men desired. 0603.

MARINE ARCHITECTS, MARINE ENGINEERS, HULL AND ENGINE DRAFTSMEN and other technically trained men for leading shipyards. Several yards are using civil, electrical, and mechanical engineers for construction of hulls or mechinery equipment, and this field of construction offers excellent opportunity for technically trained men. 0597.

FUEL ADMINISTRATION desires volunteers for engineering committees in the following counties in New York State: Wyoming and Orleans, near Buffalo; Livingston, Allegany, Ontario and Wayne, near Rochester; Franklin and Lewis, near Watertown; Herkimer, Otsego and Delaware, near Utica; Hamilton, Greene, Ulster, Sullivan and Orange, near Schenectady; Saratoga, Warren, Essex, Clinton, Washington, Columbia, Dutchess and Putnam, near Albany.

Also a real power-plant engineer to assist in checking up the questionnaires now being sent out. 0659.

FUEL ADMINISTRATION desires volunteers among the older men for office duties, meeting men, handling correspondence, etc. Location, New York office. 0598.

PRODUCTION EXPERTS. Mechanical engineers qualified as production experts for employment in district which extends from the southern portions of Ohio and Indiana to the Gulf of Mexico. Duties are to supervise the production of ordnance work at various plants engaged on Government contracts, and especially to speed up production wherever possible. Applicants should be mechanical engineers of thorough training and broad experience, who have an earning capacity of from $5000 a year upward. Positions require thorough business ability as well as technical knowledge. No one who is engaged directly on Government contracts can be employed. Maximum salary, $3600 per annum. 0658.

TECHNICAL GRADUATE, about 28 years of age, who has had some experience in installing office and shop systems; man who is physically unfit for military service or who has been placed in the limited service; one with initiative and the ability to get results preferred, even if with no previous experience in the work above named. Location Massachusetts. 0586.

ENGINEERS for special investigation work, familiar with general shop practice. Some technical education. Location Government plant on Long Island. 0602.

COST AND TIME-STUDY ENGINEERS, conversant with up-to-date shop methods. Location Government plant on Long Island. 0634.

THE U. S. NAVY GAS ENGINE SCHOOL, Columbia University, is desirous of obtaining names and addresses of men willing to enroll for training for the positions of chief engineer, warrant machinists and chief machinist mates on board the new submarines of the U. S. navy. Applicants must be men who have had extended experience in the operation of Diesel or other heavy-oil engines, and are fully capable of taking charge of Diesel engines, making ordinary repairs, foreseeing trouble, and maintaining the engines in efficient operation. Applicants should be between the ages of 21 and 35, but applications of men up to 40, if exceptionally well qualified, will be considered. The pay is attractive and the several months' training is most advantageous for future work. 0664.

CIVILIAN POSITIONS

FIELD SECRETARY for engineering organization work. Must be able to meet engineers and business men and secure their coöperation. Engineering and executive experience, tact and judgment are essential. Salary $200 to $250 per month, with exceptional opportunity. State draft classification. K. 0604.

HIGH-GRADE FOUNDRYMAN, capable of taking full charge of foundry department with a melting capacity of approximately 150 tons a day; not only a practical foundryman, but one who understands the theoretical side of foundry work, has wide experience in the production of both small and heavy castings, and possesses the necessary executive qualifications to enable him to efficiently supervise actual production work in his department. Location Ohio. J-0604.

INSTRUCTOR IN MECHANICAL ENGINEERING. Position pays a salary of $1600 a year and allows three months' vacation with pay. Work to begin September 15, 1918. Location Louisiana. J-0605.

GRADUATE MECHANICAL ENGINEER for a position leading up to chief engineer. Should have had five to ten years' experience in engineering department of a steel plant. Send résumé of education, experience and salary. Interview will be necessary. Location Pennsylvania. J-0606.

ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING in an eastern university, to have charge of classes in machine design and allied subjects; teaching and practical experience necessary. Engagement to begin October 1. J-0607.

PRODUCTION ENGINEER to take charge of cost-reduction work in Canadian shop manufacturing air compressors, rock drills and other lines. Gantt system preferred. State age, experience and salary expected. J-0608.

ASSISTANT TO CONSULTING ENGINEER for a large, nationally known manufacturing concern. Young man wanted with college training in mechanical engineering and who is in deferred classification under Selective Service Act. Experience in heating and power-plant engineering desirable. Work directly connected with the war, as company is over 75 per cent. engaged on Government work. Position permanent, with excellent opportunities for advancement. Location New York City. Apply by letter, outlining experience and stating salary expected. J-0609.

YOUNG MEN OF COLLEGE EDUCATION and some ability and training in research work. Experience in particular line not required, but a good measure of common sense and originality will be at a premium. Pay $150 to $200 per month or more for a man of undoubted ability. Headquarters Eastern New Jersey. Apply by letter. J-0610.

SALES ENGINEER of experience for position of sales manager. Must be good executive, thoroughly familiar with modern sales methods and experienced in power-plant and combustion engineering. Location Middle West. J-0611.

TECHNICAL GRADUATES specializing in power-plant and combustion engineering wanted as sales engineers. Must have good address and be either experienced salesmen or prepared to take course of training. Splendid opportunities to men possessing necessary qualifications. Location Middle West. J-0612.

YOUNG MAN to teach the elementary portion of mathematics and physics for the coming year, beginning September 17. Salary $800 to $1,000. College in New York State. J-0613.

STEAM-ENGINE DESIGNER. Man with broad experience in the design of tow-boat and marine engines. Give full details of experience, age and salary. Good opportunity for high-grade man. Apply by letter. Location Pennsylvania. J-0614.

INSTRUCTORS. Salary $1500 or $1600. Location Philadelphia. J-0615.

CHIEF DRAFTSMAN with executive ability, capable designer, competent to supervise ordering of materials and with capacity for details. Experience in general machine design, structural steel and electrical machinery. Salary $300. Location New York City. J-0618.

YOUNG MECHANICAL ENGINEER to do drafting; one with some experience in factory construction work. $35 to $40 a week. Location Newark, N. J. J-0622.

MECHANICAL ENGINEERS. Corporation doing a large percentage of Government work needs services of two engineers, preferably college graduates. In addition to mechanical engineering experience should have experience in scientific-management methods to direct and superintend a department for manufacturing, estimating and general investigation matters. Opportunity for the future is assured. In reply state age, nationality, references and present salary. J-0623.

TECHNICAL CORRESPONDENT. Man if possible not subject to draft, owing to physical reasons or on account of age, capable of taking charge of technical correspondence. Boston concern. J-0624.

INSTRUCTOR IN MECHANICAL ENGINEERING for University of Cincinnati. J-0625.

HIGH-GRADE EMPLOYMENT MANAGER. Man with college education, some employment experience, initiative and aggressive, capable of taking hold of an employment organization and developing it to meet the exacting requirements of the present day; capable of influencing men and women workers by pleasant personality, fairness and ability to get things done on time and in the right way. Salary $200 to $250 per month. State age, education, experience and names of last three employers, with the length of service in each case, as well as responsibility assumed. Appreciate photograph. Address L. W. Wallace, Assistant General Manager, Personal. J-0626.

RATE-SETTING AND TIME-STUDY WORK. Salary $35 to $40 a week, depending entirely on the man. J-0627.

DRAFTSMAN in contractor's office. Must be thoroughly experienced in conveying systems for boiler houses, ground storage plants, locomotive coaling stations, etc., and familiar with structural steel. Permanent position, good salary and opportunity for advancement to right man. State salary desired and complete experience. Apply by letter. Location Philadelphia, Pa. J-0628.

DRAFTSMAN. Competent designer and detailer. Man experienced in stationary boiler and power-plant work. Steady position and good salary. Location New York. Give age, experience, references and military status. J-0629.

INSTRUCTOR IN MECHANICAL ENGINEERING in well-known university in Maryland. College graduate with some experience in machine design and experimental engineering preferred. Salary $1700 or more, depending upon man engaged and the number of courses arranged for him to teach. J-0635.

ESTIMATING AND SALES ENGINEER. Large manufacturing company producing a complete line of mining machinery has opening for graduate mechanical engineer to assist in estimating, ultimately becoming sales engineer. Must be draft-exempt. Reply by letter. J-0636.

DRAFTSMAN—DESIGNER. Man experienced on automatic machinery for large manufacturing plant doing Government work. Permanent position. State age, education, previous experience, salary desired, etc. Location Cleveland, Ohio. J-0637.

MECHANICAL DRAFTSMAN, preferably one with experience in the design of high- or low-pressure air compressors, marine or high-speed engines. Permanent position. Location Connecticut, within 50 miles of New York City. Salary depends on past experience. J-0639.

DRAFTSMEN. Plant-layout men for general lines with knowledge of building construction and equipment. Position in Georgia. J-0640.

ESTIMATING ENGINEER, experienced in the purchasing line. Applicant should have technical training and be competent to estimate cost on construction work and mechanical equipment such as would be involved in the construction of water-filtration plants, both gravity and pressure types. Location New Jersey. J-0642.

CHIEF DRAFTSMAN to take charge of drafting room of about 120 men with company engaged in design and construction of by-product coke ovens, benzol and toluol plants. Prefer man with by-product coke-oven experience, but will consider man from other line of work, provided he has had general mechanical engineering experience and possesses good executive ability. Must be an American. Give full particulars with application; age, previous positions occupied, etc. J-0643.

SUPERINTENDENT OF TOOL ROOM. Will pay $5000 to $6000 a year to the right man, who must be capable of taking charge of toolmakers, getting out jigs and fixtures accurately and in a reasonably quick time. Should be fairly experienced not only in the making of tools and fixtures, but in the design of same. Location Buffalo, N. Y. J-0644.

ENGINEER fully capable and familiar with the design and manufacture of small motors not exceeding 2 hp. J-0645.

DRAFTSMEN on power-plant and industrial-plant design—not electrical men. Work is indirectly Government work, along the lines of fuel conservation in the New England States. Also some Government construction work. Headquarters Connecticut. J-0646.

BOILER-ROOM FOREMAN to take care of 10,000 boiler hp., operate Taylor stokers and take care of compound engines. Salary about $2000. Location Staten Island, N. Y. J-0647.

TECHNICAL GRADUATE with practical experience, preferably including marine experience, to take charge of a night class in steam-engine practice. Write, stating experience. J-0648.

TECHNICAL GRADUATE, with practical experience, to take charge of a night class in gas-engine practice. Write, stating experience. J-0649.

MACHINERY DRAFTSMAN AND ENGINEER capable of figuring stresses in all parts of punching, shearing, plate-planing, bending and rolling machinery. J-0650.

INSTRUCTORS of professional rank in electrical engineering and mechanical engineering, both positions connected with training of men for Army. Prefer men with practical experience and will consider men with no previous experience. Salary $2500 or more for first-class men. Term begins about October 1. J-0651.

MAN to take charge of employment and welfare departments. Ninety per cent. Government work and manufacture of automatic screw tools. $200 to $250 for good man. J-0652.

MEN AVAILABLE

Only members of the Society are listed in the published notices in this section. Copy for notices should be on hand by the 12th of the month, and the form of notice should be such that the initial words indicate the classification. Notices are not repeated in consecutive issues.

GENERAL OR WORKS MANAGER of a manufacturing concern. Position desired by a successful executive having extensive and exceptional experience with high-grade manufacturing concerns. Any firm needing a man to manage, who has learned how by hard knocks, will be supplied complete record on request. J-238.

STEAM-TURBINE SPECIALIST. Mechanical engineer, American, with 15 years' experience in U. S. and abroad in the designing, calculation, manufacture, testing and operation of small and large steam turbines, desires permanent position. J-239.

FUEL ENGINEER. Graduate mechanical engineer, age 35, with nine years' experience in the scientific testing of coal in all kinds of industrial plants, for one of the largest coal companies in the Middle West, desires position as combustion engineer for a large user of coal doing essential war work. At present employed. J-240.

MANAGER OF MACHINE WORKS OR SHIPBUILDING PLANT. Member, graduate mechanical engineer, wants responsible executive position with right concern. Experienced in progressive management, modern production, and handling and developing men; familiar with ship work and broad class of engineering. All-American, accurate and thorough, with first-class record in both design and construction of special machinery, machine-shop work, structural steel, power plants, piping, transmission and conveying machinery, and air compressors. Salary $7500 to $9000; only best propositions considered. J-241.

MECHANICAL ENGINEER, 1917 technical graduate, exempt from draft, with one year's experience in steam-power plant in construction, operation and maintenance. Some shop and electric railway equipment experience. Location around New York City. J-242.

TECHNICAL GRADUATE. Age 44; fifteen years' practical experience, covering machine shop, drafting room, estimating, cost accounting, rate setting, and modern shop management along production lines. J-243.

EXECUTIVE. Mechanical and production engineer with 25 years' wide, practical experience in developing, maintaining, systemizing and experimenting, and in all kinds of mechanical problems with light, interchangeable, high-grade machinery and tool production. J-244.

MANAGER, EXECUTIVE ENGINEER. Mechanical engineer, technical graduate with broad business and engineering experience. Has developed power plant for unit steam railway car and designed vital parts that are now being used on steam automobiles. Splendid in designing and construction. Ample references. J-245.

FOUNDRY SUPERINTENDENT. Member, at present employed as general superintendent of large manufacturing plant, invites correspondence from employers who may need the services of a high-grade foundry executive about December 1. Practical molder, technically trained—steel, gray iron, brass, bronzes, etc. Desires position where mechanical and technical training combined with a broad, practical experience in modern shop methods will afford opportunity to broaden experience gained in several large corporations to better advantage. Excellent references from past and present employers. Married; dependents (3); age 43. Salary not less than $5000. J-246.

ENGINEER open for engagement in manufacturing or executive sales work. Would make excellent assistant to general manager; long experience in manufacture of alternating and direct-current motors, including fractional hp. sizes, and having executive and sales experience. J-247.

EXECUTIVE, SUPERINTENDENT, OR MECHANICAL ENGINEER. American, 38 years of age, married, with a wide experience in chemical plants and general engineering work, covering maintenance and operation of industrial works. Can furnish highest references. Now superintendent of chemical plant on Pacific Coast with salary $4000 per year; will consider making a change if suitable connections can be made. J-248.

ENGINEER, highly trained, with executive experience, desires position as technical adviser or assistant to president or general manager. Engineering degrees from two technical schools and Ph. D. from one of the great American universities. Specially skilled in mathematical physics and its application to the solution of engineering problems. Twenty-five years' experience, covering chemical and testing laboratory work, metallurgical operation, design and execution of heavy construction, water power and industrial investigations, valuation and some electrical operation. Familiar with properties and uses of most engineering materials. Unmarried, physically sound and accustomed to work in emergencies without regard to hours. Reads French and Spanish readily and speaks some Spanish. Last 15 years in consulting practice. Prefers connection with interests developing large enterprise. American-born and of American parentage. Will go anywhere in United States, allied or friendly countries. Salary about $7500. J-249.

MECHANICAL ENGINEER, associate member, desires executive position requiring thorough technical training and experience with ability to handle men and situations. Class 4 of draft. J-250.

MECHANICAL ENGINEER with 15 years' experience as machinist, foreman and tool designer for interchangeable work and steel stampings; high-grade technical and practical executive. Associate member, age 36, married, technical graduate; can develop automatic labor-saving machinery and equip factory for economical quantity production. Desires position as mechanical superintendent with progressive concern. J-251.

MECHANICAL ENGINEER understanding machine and press work desires responsible position with a progressive firm. Experience in office and shop. Successful record as foreman, but desires to advance. M. I. T. man, age 28, Class 4 of draft. Prefer location in Connecticut. J-252.

CHIEF ENGINEER of medium machine-building plant wishes to connect with larger concern as assistant works manager or assistant chief engineer, chief draftsman, or any important executive position. Resourceful, rapid designer, with inventive ability; graduate M. E.; experience in factory organization and systematizing; not afraid of long hours. $3000 to start. J-253.

MECHANICAL ENGINEER. American, with 12 years' experience covering shop, time study, erection, design, sales and general office. Age 35, married, technical graduate. Employed at present. Desires position in engineering executive line with responsibility. Relations with co-workers invariably pleasant and successful. Exemplary habits and good health. Can report promptly. J-254.

MECHANICAL-ELECTRICAL ENGINEER with wide experience in internal-combustion engines, foundry and machine-shop practice and exceptional executive ability. Now at the head of a very large concern. Speaks English, French and Italian fluently. Available within a reasonable time. Minimum salary $4800. J-255.

SUPERINTENDENT OR WORKS MANAGER. American, age 43, with 22 years' practical experience with large organizations and modern methods of operation in the production of automatic, semi-automatic and single-purpose machines, also the economical manufacture of interchangeable parts from small ball bearings to large machine tools. By the proper use of a good technical education, ability to handle all classes of help, combined with tact and common sense, have been able to successfully fill positions of machinist apprentice, toolmaker, general foreman, chief draftsman, superintendent and works manager. Two years in charge of 600 men on munitions and screw-machine products. Eastern location preferred. J-256.

MECHANICAL-ELECTRICAL ENGINEER. Designer and inventor of heavy motor control devices in general use, who is employed, but inactive on account of war conditions, desires active employment in development work in which experience and ingenuity are essential. Special consideration will be given to openings likely to prove permanent. Graduate of leading technical college, fully conversant with manufacturing; member A. S. M. E., associate member A. I. E. E. J-257.

WORKS MANAGER OR SUPERINTENDENT Position desired by member successful in general manufacturing lines and with broad experience as executive in plants with foundry, pattern, polishing, plating and machine-tool departments. Thoroughly familiar with cost accounting, estimating, stock control and general office routine. Will be available early in October. J-258.

DIESEL ENGINEER with experience on stationary and marine engines desires position in this capacity, preferably with a concern engaged in Government work. Draft class 4. J-259.

ENGINEER with broad designing and production experience and six years in charge of design work desires position as engineer or chief draftsman. J-260.

CANDIDATES FOR MEMBERSHIP

TO BE VOTED ON AFTER OCTOBER 21

BELOW is a list of candidates who have filed applications since the date of the last issue of THE JOURNAL. These are classified according to the grades for which their ages qualify them, and not with regard to professional qualifications, i.e., the ages of those under the first heading place them under either Member, Associate or Associate-Member, those in the next class under Associate or Associate-Member, those in the third class under Associate-Member or Junior, and those in the fourth under Junior grade only. Applications for change of grading are also posted. Total number of applications 161.

The Membership Committee, and in turn the Council, urge the members to scrutinize this list with care and advise the Secretary promptly of any objections to the candidates posted. All correspondence in this regard is strictly confidential. Unless objection is made to any of the candidates by October 21, and provided satisfactory replies have been received from the required number of references, they will be balloted upon by the Council.

NOTE. The Council desires to impress upon applicants for membership that under the present national conditions the procedure of election of members may be slower than under normal conditions.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

Alabama

CUMMINGS, E. P., Operating Superintendent, Alabama Power Co., Birmingham
MUELLER, GROVER R., Manufacturers' Agent and Sales Engineer, Birmingham

California

BOWEN, SAMUEL R., Manager, Oil Tool Dept., S. A. Guiberson, Los Angeles
DRAKE, FRANK B., President and Manager, Johnson Gear Co., San Francisco
GRUNDEL, IRVING G., Draftsman, Union Oil Co., Oelum
IRELAND, THOMAS W., Engineer, Steam Heat Dept., Great Western Power Co., San Francisco

Colorado

PERSON, HOWARD A., Chief Engineer, United Oil Co., Florence
WILLIAMSON, EDWARD L., President and Manager, West Riverside Canal Co., Riverside

Connecticut

MORELAND, ALBERT S., General Foreman, Remington Arms Co., Bridgeport
RHEAUME, HERMAN C., Plant Engineer, Stamford Rolling Mills Co., Stamford
SMITH, CHARLES F., Engineer, Remington Arms Manufacturing Co., Bridgeport
TAPPAN, DEWITT, Assistant Superintendent, Veeder Manufacturing Co., Hartford

District of Columbia

BYRNE, HENRY H., Aeronautical and Ordnance Patent Expert, War Department, Washington
ETTENGER, ROBERT L., Consulting Mechanical Engineer, Southern Railway System, Washington
LOWE, JAMES R., Mechanical Engineer, Ordnance Department, Engineering Division, Washington
SNELLING, HENRY H., Engineer and Expert, Church and Church, Washington

Illinois

CHRISTOPHERSEN, C. BIRGER, Engineering Draftsman, Illinois Steel Co., So. Chicago
McFARLAND, OWEN D., Mechanical Engineer, Gayton & Cumfer Mfg. Co., Chicago
MERRICK, WENDELL S., Captain, 309th Engrs., 84th Div., U. S. A., Chicago
REECE, WADE W., Chief Engineer, Schulze Baking Company, Chicago

Indiana

HUTCHCRAFT, D. K., Vice President Indiana Air Pump Co., Indianapolis

Iowa

SAENGER, LOUIS P., General Superintendent, Mechanical Engineer, Clinton Sugar Refining Co., Clinton

Maryland

RACH, J. LOUIS W., Superintendent and Mechanical Engineer, E. J. Codd Co., Baltimore

Massachusetts

MAHON, THOMAS, Foreman Machinist, Becker Milling Co., Hyde Park
RANGER, JAMES A., General Contractor, Holyoke
SHEAK, EDWIN R., charge of all mechanical operations, Thomas G. Plant Co., Roxbury

Michigan

EATON, HOMER M., General Manager of Gas Companies operated by W. E. Moss & Co., Detroit
GARLAND, HARRISON W., President The M. Garland Co., Bay City
KETTLE, EDGAR U., Consulting and Research Engineer, Grand Rapids Veneer Works, Grand Rapids
KIEFER, EDGAR W., First Vice President, Port Huron Sulphite & Paper Co., Port Huron
STANBROUGH, DUNCAN G., General Superintendent, Packard Motor Car Co., Detroit
WILSON, CHARLES B., President and General Manager, Wilson Foundry & Machine Co., Pontiac

Minnesota

MORRIS, JOHN E., Secretary and Treasurer, Stacy-Bates Co., Minneapolis

Nebraska

ANDERSON, AUGUSTUS C., Consulting Engineer, Anderson and Bennett, Omaha

Nevada

LITTLE, ROBERT E., Chief Draftsman and Assistant to Master Mechanic, Los Angeles & Salt Lake R. R., Las Vegas

New Jersey

HORNING, MAURICE O., Engineer, American Gas Furnace Co., Elizabeth
RUSSEN, FRANK A., Chief Patternmaker, Safety Car Heating & Lighting Co., Jersey City

TALMAGE, Walter H., Mechanical Engineer, The Heller & Merz Co., Newark
TOLFAIR, William D., Product Engineer, Laboratories of T. A. Edison, West Orange
VAN AKEN, Lionel D., Lt. Colonel, Ordnance Department, Production Officer, E. I. du Pont de Nemours & Co., Pompton Lakes

New York

BURMISTROFF, Ivan, Assistant to Engineer, Russian Mission of Ways of Communication, New York
COHEN, Frederick W., Assistant General Manager, Metal & Thermit Corporation, New York
CRANK, Albert F., Secretary, Acting Treasurer, Chief Engineer, Conveying Weigher Co., New York
GRIFFIN, W. A., Captain, Ordnance Department, U. S. A., Assistant Production Manager, Rochester Ordnance Office, Frontier Iron Works, Rochester
HAMMOND, Edward K., Associate Editor of "Machinery," New York
JAMIESON, Charles M., Operating Planner, Wright-Martin Aircraft Corp., Long Island City
KINNEY, Price W., Employment Manager, Gleason Works, Rochester
LECHLER, Bruno C., General Manager, S. S. Hepworth Co., New York
LEVIN, Vladimir Z., Chief Inspector, Russian Mission of Ways of Communication, New York
LOOMIS, Crawford Charles, Engineer, Remington Arms U. M. C. Co., Inc., Ilion
LOWE, Aubrey L., Assistant Superintendent, Remington Arms U. M. C. Co., Inc., Ilion
REDIER, Roger P., General Sales Manager, Allied Machinery Co. of Am. New York
UPTEGRAFF, Thos M., Secretary and Manager, Defiance Paper Co., Niagara Falls
VAN GELDER, George S., 1st Lieut., Ordnance Department, U. S. A., New York
WEBB, Daniel J. H., Superintendent and Mechanical Engineer, Franklin Contracting Co., New York
WIKANDER, Oscar R., Consulting Engineer, S. K. F. Administration Co., New York
WILSON, James A., Engineer, Corning Glass Works, Corning

Ohio

BLITZ, Edgar G., Time Study and Efficiency Engineer, Toledo Scale Co., Toledo
FAUZON, Arturo, Mechanical Engineer, The World's Products Research Co., Cleveland
GREEN, Carl R., Manager and Owner, Green Engineering Co., Dayton
McCORMACK, Daniel J., Hydraulic Engineer, The Wellman Seaver Morgan Co., Cleveland
NONNEMAN, I. W., Chief Engineer, the Borden Co., Warren
SAUZEDDE, Claude, Manufacturing Engineer, Steel Products Co., Cleveland
SCHOENBERGER, John H., Draftsman and Designer, The Lunkenheimer Co., Cincinnati
STOLBERG, Charles A., Major, Ordnance Department, U. S. A., Maxwell Motor Co., Dayton
WALTZ, Burt A., Department Planning Engineer, The B. F. Goodrich Co., Akron
WEAVER, Thomas D., Chief Engineer, Humphryes Mfg. Co., Mansfield

Oklahoma

CRAIG, Clyde B., Manager, Mid-West Branch, Bessemer Gas Engine Co., Tulsa

Oregon

KINCAID, Morden F., Mechanical Valuation Engineer, Spokane, Portland & Seattle Ry., Portland

Pennsylvania

AYARS, Allan M., Efficiency Engineer, Landis Tool Co., Waynesboro
BURDICK, Frederick H., Member of Firm, Standard Engineering Co., Pittsburgh
BUSH, Paul H., Assistant and Chief Draftsman, Frankford Arsenal Tool Division, Frankford Arsenal
COLEMAN, Harry S., Assistant Director, Mellon Institute of Industrial Research, Pittsburgh
ELLIS, Roy M., Manager, A. H. Fox Gun Co., Philadelphia
HEARSEY, Winthrop O., Superintendent of Machine Shop No. 5, Bethlehem Steel Co., Bethlehem
HILTEBEITEL, M. M., Power Apparatus Engineer, Westinghouse Elec. & Mfg. Co., Philadelphia
McDOWELL, Elmer K., Chief Works Engineer, Donora Steel Works, Donora
MEISENHELTER, Lewis R., Proprietor and Owner, L. R. Meisenhelter Machinery Co., Philadelphia
MENISH, John R., Chief Mechanical Engineer, Pennsylvania Lubricatng Co., Pittsburgh
NEWHALL, Ezra A., Designer and Draftsman, Rolling Mill Machinery, R. S. Newbold & Son Co., Norristown
RYAN, John Thomas, Vice President and General Manager, Mine Safety Appliances Co., Pittsburgh
SHARP, Robert E. B., Assistant Hydraulic Engineer, I. P. Morris Department, William Cramp & Sons Ship Engine Bldg. Co., Philadelphia
SHEARER, Harry T., President, General Manager, H. T. Shearer Machine Co., Waynesboro
SLEICHER, Charles A., President, Queen's Run Fire Brick Co., Lock Haven
TERHUNE, Howard, Designer and Assistant Sales Manager, Chambersburg Engrg. Co., Chambersburg
WEGMAN, Leroy A., Aeronautical Mechanical Engineer, Naval Aircraft Factory, Navy Yard, Philadelphia

Rhode Island

JENCKES, Robert A., Department Manager, General Fire Extinguisher Co., Providence

South Carolina

MAYO, James B., Engineer and Inspector, Factory Insurance Association, Greenville

Tennessee

HOLT, Herbert F., Consulting and Contracting Engineer Practice. Knoxville

Virginia

MOSS, William D., Manager, Capitol Motor Corp., Richmond

Wisconsin

HUEVLER, William, Mechanical Appraiser, The American Appraisal Co., Milwaukee

Canal Zone

MORRIS, Thomas C., Assistant Engineer, Panama Canal, Balboa Heights

France

INGLIS, Henry B., Aviator in United States Service. American Expeditionary Forces

Java

KNEPPERS, Jos. M., Engineer, Harrisons & Crosfield, Ltd., Batavia

Mexico

ARIZPE, Emilio, Manager, Aurora Cotton Spinning & Weaving Mill, Saltillo, Coah.

South America

WHEELER, Burr, Resident Engineer, Chile Exploration Co., Tocopilla, Chile

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Illinois

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Maryland

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DAVIS, Frederick H., Mechanical Engineer, Balbach Smelting & Refining Company, Newark

New York

ARNTZEN, Asbjorn, Assistant Mechanical Engineer, F. L. Smith & Co., New York

Ohio

DAVIS, Howard E., Mechanical Superintendent, The Austin Co., Cleveland
WALTERS, Carl F., Chief Engineer, Safe Cabinet Co., Marietta

Pennsylvania

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TIKALSKY, Francis P., Section Head in machine and analysis Department of Planning Division, Western Electric Co., Inc., Hawthorne

Iowa

OGDEN, Frank F., 2nd, Consulting, Designing and Supervising Engineer and Architect, Expert Draftsman, Eddyville

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JOHNSON, Robert A., President and Manager, Franklin Machine and Tool Co., Springfield

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KERSHAW, Adolphus L., First Lieutenant, Ordnance Department, U. S. A., Eng. Div., Motor Equipment Section, Maxwell Motor Co., Detroit
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Minnesota

ROMERO, Cirilo, Instructor in Marine Steam Engineering at the U. S. Navy Training School, University of Minnesota, Minneapolis

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BROOK, Victor, Publicity Engineer with title of "Field Service Manager," New York

CHATEL, FRED. J., Ensign, U. S. N. R. F.—U. S. S. "Huntington," New York
FRIEDMAN, JNO. H., Captain, Assistant Superintendent of Shops, Watervliet Arsenal, Watervliet
HYATT, JOHN E., U. S. Naval Reserve Officers' Material School, Scarsdale
JACOBS, LORING H., U. S. Navy, Bureau of Construction and Repair, Avation Section, care Superintending Constructor of Aircraft, Buffalo
JARECKIE, EUGENE A., Assistant Engineer of Honolulu Iron Works Co., New York
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Oklahoma

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WHITAKER, JOHN C., Production Engineer, Midvale Steel & Ordnance Co., Nicetown, Philadelphia

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Connecticut

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Delaware

KUO, CHENG C., Ship Building, Harlan & Holingsworth Corp., Wilmington

District of Columbia

OAKES, CHARLES E., Associate Electrical Engineer, Bureau of Standards, Washington

Illinois

ALLEN, HAROLD F., Mechanical Engineer, Link-Belt Co., Chicago

Maryland

MOORE, WALTER E. J., Chemical Warfare Section, Edgewood Arsenal, Edgewood

Massachusetts

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DUNCAN, JOSEPH B., Industrial Engineer, New England Westinghouse Co., Chicopee Falls
LENK, DAVID A., District Gauge Supervisor, Gauge Section, Insp. Division, Ordnance Department, U. S. A., Boston
WILLIAMS, FRED C., JR., Assistant to Mechanical Engineer, The Fiberloid Corp., Indian Orchard

Michigan

CULVER, EDWARD P., Second Lieutenant, Air Service, Aeronautics, U. S. A., Instrument Officer, Mt. Clemens
GILLIARD, PIERRE G., Chief Engineer and Factory Manager, Michigan Wheel Co., Grand Rapids
HERBERT, ROBERT H., Inspector of Naval Gun Mounts, Linderman Steel Mach. Co., Muskegon

New Hampshire

NEWTON, WILBUR F., Marine Draftsman, Portsmouth Navy Yard, Portsmouth

New Jersey

GROB, JOHN J., Construction Engineer for Main Power House, H. & M. R. R., Jersey City

New York

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FOX, SAMUEL M., Ensign, U. S. Naval Reserve Force, Aeroplane Inspection, Buffalo
GIES, CLAUDE T., Mechanical Designer, Otis Elevator Co., New York
GUTHRIE, ROBERT G., Engineer, Laboratory of the Curtiss Aero Corporation, Buffalo
KOSWICK, ALEXANDER A., Assistant to Buyer of Fabricated and Special Tools, Wright, Martin Aircraft Corp., New York

North Carolina

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Pennsylvania

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DUDA, WENTZEL R., Designer, United Engineering and Foundry Co., Pittsburgh
FAGERSTROM, OTTO, Draftsman, Carnegie Steel Co., Duquesne

South Carolina

BLACKWELDER, CHARLES D., Assistant Chief Mechanical Engineer, American Machine & Manufacturing Co., Greenville

Texas

GRAEF, LOUIS F., Draftsman, American Smelting & Refining Co., El Paso

Vermont

KEATOR, SIMON P., Cost Engineer, Vermont Farm Mach. Co., Bellows Falls

Virginia

WIDELL, BERNDT A., JR., Assistant Engineer, Coast Artillery Corps, Fifth Training Co., Fort Monroe

CHANGE OF GRADING

PROMOTION FROM JUNIOR

Minnesota

HANSON, JOHN J., First Lieutenant, Ordnance R. C., Inspection Section, Carriage Division, Minneapolis Steel & Machinery Co., Minneapolis

New York

FRITZ, AIME L. G., Superintendent of Construction, H. R. Kent & Co., New York
ROMAN, HENRY, in Charge of the Designing of Liquid Air Plants, Air Nitrates Corp., New York

Pennsylvania

LAMOREE, JAMES K., Mechanical Engineer, American Sheet & Tin Plate Co., Shenango Works, Newcastle

Rhode Island

BROWN, WENDALL S., Industrial Engineer, F. P. Sheldon & Sons, Providence

PROMOTION FROM ASSOCIATE-MEMBER

Connecticut

JENNINGS, IRVING C., Vice President and General Manager, Chief Engineer, Nash Engineering Co., South Norwalk

Missouri

MACKINNON, JAMES A., Superintendent of Forge Shop, Scullin Steel Co., St. Louis

New York

HUBBARD, FRANK B., Plant Engineer, Pierce Arrow Motor Car Co., Buffalo
MOORE, WILLIAM J., Consulting Engineer, Inter-Continental Machinery Corp., New York

Pennsylvania

FICKES, ALFRED C., Mechanical Engineer, Lancaster Iron Works, Inc., Lancaster
FREEMAN, PERRY J., Engineer of Tests, Pittsburgh Testing Laboratory, Pittsburgh

PROMOTION FROM ASSOCIATE

Philippine Islands

DUFFY, OWEN, Superintendent and Chief Engineer, Insular Cold Storage and Ice Plant, Manila

SUMMARY

New applications	161
Applications for change of grading:	
Promotion from Junior	5
Promotion from Associate-Member	6
Promotion from Associate	1
Total	173

SUMMARY SHOWING AVERAGE AGE AND POSITIONS OF APPLICANTS ON BALLOT SEPTEMBER 23, 1918

Average age of applicants:	
Members	40
Associates	39
Associate-Members	31
Juniors	25
Calculator	1
Chemical Engineer	1
Chief Engineer	4
Contracting Engineer	2
Construction Engineer	4
Consulting Engineer	1
Designers	6
Draftsmen	5
Chief Draftsmen	7
Estimator	1
Electrical Engineer	1
Executives (Pres., Vice Pres., Secy. Treas., Mgrs.)	27
Foremen	2
Assistant Foreman	1
Inspectors	2
Assistant Inspector	1
Instructors	2
Industrial Engineer	1
Managing Engineer	1
Master Mechanics	2
Mechanical Engineers	40
Assistant Mechanical Engineers	2
Power Engineers	2
Production Engineers	2
Professors	2
Purchasing Assistant	1
Resident Engineer	1
Sales Agent	1
Sales Engineers	6
Sales Managers	2
Superintendents	12
Assistant Superintendents	5
Supervising Engineers	2
Works Engineers	2
Miscellaneous	35
UNITED STATES GOVERNMENT SERVICE:	
Majors	2
Captains	2
First Lieutenants	6
Second Lieutenants	3
Ensigns	2
Sergeant	1

SELECTED TITLES OF ENGINEERING ARTICLES

THE section Selected Titles of Engineering Articles comprises an index to current articles on mechanical engineering and related subjects.

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Chief attention is paid to articles directly concerned with the branches of mechanical engineering. When it is thought they will be of interest or value to mechanical engineers, however, other articles are listed, in the realms of physics and chemistry; civil, mining and electrical engineering, technology, etc.; and in subjects in broadly related fields such as training and education, safety engineering, fire protection, employment of labor, welfare work, housing, cost keeping, patent law, public relations, etc. Cross-references are introduced and where the titles themselves are not sufficiently descriptive, explanatory sentences are appended. The main abbreviations used in the items are given at the bottom of this page.

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AERONAUTICS

Aerostatics

Military Aerostatics, H. K. Black. Aerial Age, vol. 7, nos. 22 and 23, Aug. 12 and 19, 1918, p. 1064, 1 fig., pp. 1118-1119, 1 fig. (Aug. 12). Features of the Cacquot observation balloon; (Aug. 19). Action of automatic valve. (Continuation of a serial.)

Altitudes

The Flight of an Aeroplane at Different Altitudes, L. de Bazillac. (Translated from original French by B. Bruce-Walker). Flight, vol. 10, nos. 28 and 29, July 11 and July 18, 1918, pp. 779-781, 4 figs., and pp. 811-813, 3 figs. (July 11). Equations involved in the study of two ways of flying the aeroplane under the thrust of contact: 1, at constant speed and increasing altitude, the engine running normally all the time; 2, keeping altitude constant by reducing speed of engine in proportion in which the oil and petrol are consumed. (July 18). Curves and formulæ; resistances per unit weight in terms of angle of attack. (Continuation of serial.)

Engine Pistons

Report on Aluminum Pistons from 230 HP. Benz Engines. Aeronautics, vol. 15, no.

NOTE.—The abbreviations used in indexing are as follows: Academy (Acad.); And (&); American (Am.); Associated (Assoc.); Association (Assn.); Bulletin (Bul.); Bureau (Bur.); Canadian (Can.); Chemical or Chemistry (Chem.); Electrical or Electric (Elec.); Electrician (Elecn.); Engineer [s] (Engr. [s]); Engineering (Eng.); Gazette (Gaz.); General (Gen.); Geological (Geol.); Heating (Heat.); Industrial (Indus.); Institute (Inst.); Institution (Instn.); International (Int.); Journal (Jl.); London (Lond.); Machinery (Machy.); Machinist (Mach.); Magazine (Mag.); Marine (Mar.); Materials (Matls); Mechanical (Mech.); Mining (Min.); Municipal (Mun.); National (Nat.); New England (N. E.); New York (N.Y.); Record (Rec.); Refrigerating or Refrigeration (Refrig.); Review (Rev.); Railway (Ry.); Scientific or Science (Sci.); Society (Soc.); United States (U. S.); Ventilating (Vent.); Western (West.); State names (Ill., Minn., etc.); Proceedings (Proc.); Transactions (Trans.); Supplement (Supp.).

247, July 10, 1918, pp. 46-48, 4 figs. Details of design and result of a metallurgical analysis of the composition of the alloy carried out by R.A.E. Engine was taken from the Aviatik biplane G.130, captured Feb. 12, 1918. Issued by Technical Dept., Aircraft Production, Ministry of Munitions. Accounts also published in Flight, vol. 10, no. 27, July 4, 1918, pp. 744-745, 4 figs. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, p. 361, 2 figs.; Aviation, vol. 5, no. 2, Aug. 15, 1918, p. 93, 1 fig.; Engineering, vol. 106, no. 2740, July 5, 1918, p. 18, 4 figs.

Engine Temperature Control

Making the Aviation Engine Fit for Any Altitude. Sci. Am., vol. 119, no. 6, Aug. 10, 1918, p. 109. Automatic temperature control used in Sturtevant engine.

Engines

The 180 hp. Mercedes Aero-Engine. Aviation, vol. 5, no. 2, Aug. 15, 1918, pp. 98-101, 10 figs. Report on design of engine issued by the Technical Department, Aircraft Production, British Ministry of Munitions.

The Design of Aeroplane Engines, John Wallace. Aeronautics, vol. 15, nos. 247 and 248, July 10 and July 17, 1918, pp. 44-46, 5 figs., and pp. 59-61, 3 figs. (July 10), Air and water cooling of the cylinders; indicator diagram; compression ratio; mean effective pressure; (July 17), power; construction of theoretical indicator diagram; comparison of results. (Continuation of serial.)

Individual Types

Report on the Friedrichshaffen Bomber. Flight, vol. 10, nos. 27, 28 and 29, July 4, 11 and 18, 1918, pp. 737-741, 770-773, 41 figs., and pp. 793-796, 15 figs. F.D.H. G.3 brought down by anti-aircraft fire at Ishergues on Feb. 16. Construction of wings, struts, ailerons, fin and fixed tailplanes; elevators, rudders, bracing, fuselage, engines, radiators, oil pump, petrol tanks, pipings, and propeller. Issued by Tech. Dept., Aircraft Production, Ministry of Munitions. (July 18), Controls; landing gear; instruments; bombs and bomb gear; fabric. (Concluded.)

Some War-Time French Airplanes and Hydroplanes. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 304-309, 5 figs. Details of the machine design and construction, also their machine-gun and other equipment. Type of motor mostly used. Some well-known fighting planes of widely varying types. (Second of series.)

The L.V.G. Biplane Type C.V. (Translation from L'Aérophile). Aerial Age, pp. 1122-1123. Comparative specifications of L.V.G. biplanes C.II, C.IV, C.V, and Rumpler C.IV.

The Roland Single-Seater Chaser, D II. Flight, vol. 10, no. 28, July 11, 1918, pp. 765-767, 8 figs. Dimensions, construction of fuselage, form of planes, shape of tail, and armament. (Translated from L'Aérophile.) Also published in Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 267-268, 2 figs. Mechanical details of fast machine of light construction; fuselage built of plywood covered with fabric.

The S.E. 5A Single Seater Fighter. Automotive Industries, vol. 39, no. 8, Aug. 22, 1918, pp. 315-317, 2 figs. Mechanical details of British machine adopted by U. S. Army authorities; weighs 1554 lb. without load and is equipped with 200 hp. Hispano engine.

Instruments

Navigation Instruments of Our Aerial Pilots. Sci. Am., vol. 119, no. 7, Aug. 17, 1918, pp. 141-142. Tachometer, air speed indicator, altimeter, airplane compass, airplane clocks, pressure gages, radiator thermometer, banking indicator and Aldis sight.

Italian Air Service

Plans and Accomplishments of the Italian Air Service. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 272-276, 13 figs. Types of machines that have been developed.

Metal Fittings

Strut Sockets and Other Sheet-Metal Airplane Fittings, Fred H. Colvin. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 253-256, 15 figs. Illustrated description of making of built-up combinations of sheet-metal stampings and of forgings and stampings.

Model Aeroplanes

Model Aeroplane Building as a Step to Aeronautical Engineering. Aerial Age, vol. 7, no. 22, Aug. 12, 1918, 1 fig. Drawing giving size and dimensions. (To be continued.)

Model Aeroplanes, F. J. Camm. Aeronautics, vol. 15, no. 248, July 17, 1918, p. 68. Study of problem of maintaining coincidence of centers of pressure and gravity in aeroplane flying. (To be continued.)

Mufflers

Exhaust Headers and Mufflers for Airplane Engines, Archibald Black. Gas Eng., vol. 20, no. 9, Sept., 1918, pp. 429-436, 14 figs. Types that have been used and are being used; figures from tests of loss due to muffler; list of references to other literature. Also published in Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 145-157, 15 figs. Paper presented before S.A.E.

Propellers

Notes on Airscrew Analysis, M. A. S. Riach. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 41-42, 2 figs. Modifications introduced into the original theory, outlined in The Screw Propeller in Air, Proc. Aero. Soc., Mar. 21, 1917, in order to take account, in a quantitative manner, of the conception of a rotation set up in the fluid both before and behind the actuator disk. (Continuation of serial.)

Predicting Strength and Efficiency of Airplane Propellers, F. W. Caldwell. Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 152-155. Formulæ and curves; Conventional design compared to adjustable-pitch propeller; efficiency under climbing conditions; comparison of climbing rates; engine with constant torque. (Concluded.) Also published in Aerial Age, vol. 7, no. 21, Aug. 5, 1918, pp. 1011-1018, 14 figs.

The Efficiency of an Airscrew, M. A. S. Riach. Aeronautics, vol. 15, no. 247, July 10, 1918, pp. 38-39. Examination of the quantities in the formula for the efficiency of any blade element, $N^1_x = \tan A/\tan (A^1 + \gamma^1)$ derived in "The Screw Propeller in Air," Proc. Aero. Soc., Mar. 21, 1907.

Wooden Wings for the Modern Mercury. Motor Boating, vol. 22, no. 2, Aug. 1918, pp. 22-23. Various processes employed by the French in the manufacture of propellers for their airplanes.

Royal Aircraft Factory

Products of the Royal Aircraft Factory. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 236-238, 12 figs. Models of planes developed by British Government. Further development work left to private concerns.

Standards

International Aircraft Standards. Aeronautics, vol. 15, no. 248, July 17, 1918, pp. 66-67. Specifications for aeroplane spar varnish; specifications for mercerized cotton aeroplane fabric. (Continued.)

Steel Tubes

Steel Tubes Manipulation and Tubular Structures for Aircraft, W. W. Hackett and A. G. Hackett. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 315-318. Front forks for cycles; tapered tubes; tubular liners or reinforcements; tube manipulation; tubular joints in aircraft construction; soft-soldered joints; tests on soldered joints; brazing; silver-soldering; welding. (Second of series.)

Wing Fabrics

Cotton Airplane Fabric, S. Wakefield. Textile World Jl., vol. 54, no. 7, Aug. 17, 1918, pp. 37-39, 1 fig. Construction of yarn and cloth for standard specifications.

Wing Ribs

A New Method for the Testing of Airplane Wing Ribs, I. H. Cowdrey. Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 140-144, 5 figs. Shows how load application and distribution are controlled by a series of rubber bands, and describes apparatus employed.

See also Machine Tools (Propeller-Shaping Machine); Military Engineering (Anti-Aircraft Firing); Testing and Measurements (Balloon Fabrics).

AIR MACHINERY

Lubrication

Lubrication of Air Compressor Cylinders, W. H. Callan. Power, vol. 48, no. 7, Aug. 13, 1918, pp. 229-230. Résumé of experience showing that a light mineral oil is the lubricant to use.

Soot Blowers

Soot Blowers for Vertical and Hollow Stay-Bolt Boilers. Power, vol. 48, no. 7, Aug. 13, 1918, pp. 222-228, 21 figs. Details of various systems employed; protection for blower elements in high-temperature zones; blowers for hollow-staybolt boilers; continuous ash removal.

Tire Pumps

Official Test of Tire Pumps. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, p. 243, 1 fig. Curve showing r.p.m. of pump against seconds required to inflate tire, drawn from results obtained at laboratory of Automobile Club of America, New York, with the Cassco power tire pump.

Turbo Compressors

Turbo Air Compressor at the Holbrook Colliery. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 113-115, 7 figs. A 750-hp., 2-stage, reciprocating air compressor driven through helical gearing by a mixed-pressure turbine. Description of unit and its auxiliaries.

Ventilating Fan

New Ventilating Fan at Hardwick Collieries. Iron & Coal Trades Rev., vol. 97, no. 2630, July 26, 1918, p. 91, 1 fig. A 15-ft. fan replaced by smaller one of the multi-blade type.

See also Mines and Mining (Sprayers).

BRICK AND CLAY

Canadian Clay

Report of the Clay Resources of Southern Saskatchewan, N. B. Davis. Can. Department of Mines, no. 468, 1918, 93 pp., 21 figs. Report based on field work and laboratory tests, containing information regarding geological position, locality, and availability of each deposit, and behavior of samples tested in laboratories.

Clay Burning

Burning Clay Wares, Ellis Lovejoy. Clay-Worker, vol. 70, no. 2, Aug. 1918, pp. 128-130. Machine handling and setting; open-top continuous kilns. (Continuation of serial.)

Fire Brick—the Age of Clay Products. Brick & Clay Rec., vol. 53, no. 5, Aug. 27, 1918, pp. 369-371. How two plants in Pennsylvania are turning out their product.

See also Pipe (Clay Pipe).

BRIDGES

Concrete Bridges

Canadian Pacific Railway Viaducts at Toronto. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 123-124. How it was possible to build two reinforced-concrete bridges 386 ft. long and 90 ft. high, having spans of 35 ft.

Concrete Highway Bridge Design. Surveyor, vol. 54, no. 138, July 5, 1918, p. 8. Ontario Highway Department's specifications.

Rebuilding the C. B. & Q. R. R. Bridge Over the Platte River, Near Grand Island, Neb. Ry. Rev., vol. 63, no. 4, July 27, 1918, pp. 117-120, 10 figs. Reinforced-concrete slabs on concrete piers with reinforced-concrete pile foundation.

Steel Bridges

Bridge Across the River Vistula at Warsaw. Engineer, vol. 126, no. 3265, July 26, 1918, pp. 80-81, 5 figs. Description of 504-meter bridge completed at outbreak of war.

Four-Span Steel Bridge Over the Nicolet River. Contract Rec., vol. 32, no. 27, July 3, 1918, pp. 519-520. Dimensions and brief account of erection.

The Economics of Steel Arch Bridges, T. K. Thomson, C. E. Fowler, W. B. Farr and H. P. Van Cleve. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 843-870, 9 figs. Study and classification of 100 structures. Discussion of J. A. Waddell's paper. (Concluded.)

The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City, C. E. Chase and O. H. Ammann. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 759-766. Discussion of O. H. Ammann's paper.

Stresses

Why Do Some Bridges Stand Up? E. H. Darling. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 655-656, 2 figs. Table of estimated stresses under various conditions.

Truss Spans and Towers

New Bridge on the B. & L. E. a Notable Structure. Ry. Age, vol. 65, no. 8, Aug. 23, 1918, pp. 345-351, 16 figs. Continuous trusses and unique construction methods noted.

Oregon-Washington Railroad and Navigation Company's Portland Bridge. Ry. Gaz., vol. 29, no. 2, July 12, 1918, pp. 46-50, 3 figs. Structure and substructure details of the three riveted truss spans and of the two towers between which the central span is lifted vertically.

Wilson Bridge

Wilson Bridge, Over the Rhone, at Lyon (Le pont Wilson, sur le Rhone, à Lyon), A.

Dumas. Génie Civil, vol. 73, no. 2, July 13, 1918, pp. 21-28, 15 figs. Details of construction, sections and dimensions.

BUILDING AND CONSTRUCTION

Coaling Station

An Example of Modern Coaling Station Construction. Ry. Gaz., vol. 29, no. 5, Aug. 2, 1918, pp. 127-128, 4 figs. Ground plan showing track arrangement and elevation of towers of new reinforced-concrete structure at Manchester, N. Y.

Condensation on Under Surface of Roof

See Roof Construction below.

Coördination

Coördination Saves Six Weeks' Construction Time on Big Building. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 300-304, 5 figs. Duplicate equipment throughout eliminates plant delays; manual operations proceed on time-table schedule, promoting *esprit de corps*.

Grain Warehouse

New Reinforced-Concrete Grain Warehouse in Genoa (Nuovo magazzino in cemento armato per grani nel porto di Genova). Ingegneria Italiana, vol. 2, no. 30, July 11, 1918, pp. 17-23, 11 figs. General plans and dimensions.

Mill Buildings

A Very Modern Manufacturing Plant, W. H. Roberts. Wood-Worker, vol. 37, no. 6, Aug. 1918, pp. 32-33, 6 figs. Notes on the fireproof construction, equipment, methods, safety devices, ventilation, lighting, and sprinkler system of Weiss Mfg. Co., Monroe, Mich., manufacturers of sectional bookcases, office furniture, etc.

Is Wood a Suitable Material for the Construction of Mill Buildings? W. Kynoch and R. J. Blair. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 622-623, 2 figs. Examination of facts from a technical standpoint.

Roof Construction

The Relative Effectiveness of Various Types of Roof Construction in Preventing Condensation on the Under Surface, W. S. Brown. Building News, vol. 115, no. 3317, July 31, 1918, pp. 80-81, 1 fig. Graphs obtained mainly from experiments made in testing laboratory of F. P. Sheldon and Son, Providence, R. I. Paper before Nat. Assn. Cotton Mfrs.

Shipyard

Concrete Shipyard at Wilmington, N. C., A. G. Monks. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 452-454. Description of plant erected by Liberty Shipbuilding Co., Boston, Mass., for building concrete ships.

Stacks

Boiler House as Stack Foundation, L. C. Huff. Power, vol. 48, no. 5, July 30, 1918, pp. 150-152, 5 figs. Four-story concrete building used as foundation for 240-ft. steel stack; supports and bracing to withstand wind pressure.

Warehouse

Army Depot at Chicago is Large Concrete Warehouse, A. Epstein. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 269-270, 1 fig. Floor area 29 acres in 6-story building; tracks on first floor; tunnels for trucking and utilities.

See also Cement and Concrete (Roofs); Labor (Housing).

CEMENT AND CONCRETE

Buildings

Economy in the Design of Concrete Buildings, C. W. Mayers. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 659-662. Remarks and suggestions. Paper before Am. Concrete Inst.

Cement Gun

Varied Applications of the Cement Gun. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 40. Recent uses and composition of mixture applied by cement gun.

Columns

Economy in the Design of Columns for Concrete Buildings, Clayton W. Mayers. Contract Rec., vol. 32, no. 36, Sept. 4, 1918, pp. 712-716, 6 figs. Aberthaw Construction Co. Before Am. Concrete Inst.

Temperature Tests on Concrete Columns, W. A. Hull. Contract Rec., vol. 32, no. 31, July 31, 1918, pp. 605-607. Résumé of tests on gravel and limestone concrete columns carried out in the U. S. Bureau of Standards. Abstract of paper before Am. Concrete Inst.

Dams

Lukewarm Concrete Enough Precaution for Zero Weather Dam Work. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 260-262, 3 figs. Perfect bond and sound concrete secured by placing 50-deg. mixture on frozen surfaces; concreting kept up in heavy frosts.

Deterioration

Action of Sea Water on Concrete in Structures Exposed to Tides (Action de l'eau de mer sur les ouvrages en béton exposés aux marées), E. R. Matthews. Mémoires et Comptes Rendus des Travaux de la Société des Ingénieurs Civils de France, year 71, nos. 1-3, Jan.-Mar. 1918, pp. 40-42. Results of experiments made at Hull, England, on 6-in. cubes. Abstract of paper before Soc. of Civ. Engrs., France.

Concrete in Alkali Soil at Saskatoon, H. McI. Weir. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 153-154. Physical condition and appearance of a number of cases in alkali ground and comparison of these with conditions found in ground free from alkali.

Deterioration of Concrete, B. Stuart McKenzie. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 150-152. Examples of deterioration under various conditions and results of experiments conducted by City Analyst of Winnipeg.

Foreign Concrete Regulations

English and Canadian Concrete Regulations, W. W. Pearse. Can. Engr., vol. 35, no. 7, Aug. 15, 1918, pp. 143-147. Comparison between Toronto's by-law regulating reinforced-concrete construction and new by-law of London County Council which adopts 180 lb. per sq. in. shearing stress and favors hooking the ends of reinforcing in beams.

Mortars

Ancient and Modern Mortar, W. J. Dibdin. Concrete Age, vol. 28, no. 5, Aug. 1918, p. 19. Abstract of paper before Faraday Soc. of London.

Proportioning the Materials of Mortars and Concretes by Surface Areas of Aggregates, L. N. Edwards. Contract Rec., vol. 32, No. 31, July 31, 1918, pp. 599-604, 12 figs. Methods, materials used, results obtained and phenomena observed in a series of experimental tests undertaken to develop the practical application of this method. Abstract of paper before joint meeting of Am. Concrete Inst. and Am. Soc. for Testing Materials.

Mixing

Effect of Time of Mixing on the Strength of Concrete, D. A. Abrams. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 132-134, 5 figs. Comparison of hand and machine mixing; effect of rate of rotation of mixer drum; effect of age on strength; curves showing temperature of mixing water against compressive strength; yield and density of concrete. (Concluded.)

Reinforced Concrete

Discussion on Final Report of the Special Committee on Concrete and Reinforced Concrete, C S. Bissell. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 897-903. Method for designing reinforced beams and slabs from equations given in report. (Concluded.)

Roofs

Concrete Roof Specifications. Contract Rec., vol. 32, no. 36, Sept. 4, 1918, p. 716. Recommendations of Sandusky Cement Co.

Strength of Concrete

Some Tests on the Effect of Age and Condition of Storage on the Compressive Strength of Concrete, H. F. Gonnerman. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 135-137, 4 figs. Results of tests made at the Univ. of Ill. Paper before Am. Concrete Inst.

Swimming Pools

How to Build Reinforced Swimming Pools. Concrete Age, vol. 28, no. 5, Aug. 1918, pp. 10-12, 3 figs. Suggestions for designing.

Ties

Concrete on Railways. Ry. Gaz., vol. 29, no. 3, July 19, 1918, pp. 72-74, 7 figs. Shapes and sizes of blocks used as ties for rails.

Trestles

Reinforced Concrete Trestles at North Toronto. Ry. Age, vol. 65, no. 7, Aug. 16, 1918, pp. 289-291, 7 figs. Unique details developed in viaducts designed as a substitute for steel construction.

See also Fuel and Firing (Waste Heat); Marine Engineering (Concrete Ships).

CHEMICAL TECHNOLOGY

Ammonia

Notes on the Catalytic and Thermal Synthesis of Ammonia, E. B. Maxted. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 232T-235T, 3 figs. Discussion of some points in the Haber synthesis and of methods employed and results obtained in connection with measurement of ammonia equilibrium at high temperatures.

The "Direct" Process of Sulphate Making in Gas-Works, W. S. Curphey. Gas Jl., vol. 143, no. 2879, July 16, 1918, pp. 111-113. Experiments on rotation system; effect of seasonal changes on ammonia; discussion of results of investigations carried out at various works. From annual report of chief alkali inspector. (Continuation of serial.)

Analysis, Steel

Combustion Train for Carbon Determination, J. B. Stetser and R. H. Norton. Iron Age, vol. 102, no. 8, Aug. 22, 1918, pp. 443-445, 1 fig. Apparatus giving results in 6 min. and meeting color-test inaccuracies arising from varying heat treating of samples.

The Determination of Cobalt and Nickel in Cobalt Steel, W. R. Schoeller and A. R. Powell. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 304-306. Application of process based on precipitation of hexammine cobaltons and hexammine nickelous iodides by means of potassium iodide in strongly ammoniacal solution, the precipitation of the trivalent metals by the ammonia being prevented by addition of tartaric acid. Paper before British Iron & Steel Inst. Published also in Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 359-360; Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 22, 5 pp.

Analysis (Varia)

A Method for the Separation and Determination of Barium Associated with Strontium, F. A. Gooch and M. A. Soderman. Am. Jl. of Sci., vol. 46, no. 273, Sept. 1918, pp. 538-540. Results of attempt to adapt process used for separating barium from calcium and magnesium, which consists in throwing the barium out of solution by the addition of a 4:1 mixture of concentrated hydrochloric acid and ether.

A New Method of Estimating Zinc in Zinc Dust, L. A. Wilson. Eng. & Min. Jl., vol. 106, no. 8, Aug. 24, 1918, pp. 334-336, 1 fig. Abstract from paper before Am. Soc. for Testing Materials.

Charcoal

Charcoal and Allied Industries (La destilación de la madera). Boletín de la Sociedad de Fomento Fabril, year 35, no. 4, Apr. 1918, pp. 244-249. Processes used with different woods; obtainable by-products and their temperatures of distillation. (To be continued.)

Coal-Tar Products

Constituents of Coal Tar, P. E. Spielmann. Gas Jl., vol. 143, no. 2879, July 16, 1918, p. 114. Enumeration of multiple six-ring and of five-member ring hydrocarbons. (Continuation of serial.)

Notes on the Commercial Fractional Separation of Benzene, Toluene, and Xylenes, T. H. Butler. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 220T-222T, 5 figs. Factors making efficiency in plants of coal-tar hydrocarbons.

The Recovery of Light Oils and Refining of Toluol. Engineering, vol. 106, no. 2743, July 26, 1918, pp. 83. Sources of light oils, coal gas, water gas and oil gas; outline of processes; scrubbers, heat exchangers, superheater and stripping still, wash-oil cooler, condenser, separator, crude rectifying stills, agitator and rectifying stills.

Dyestuffs

Dyestuffs, L. J. Matos. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 187-209, 8 figs. History of development of dye industry; chemistry of industry; diagrams illustrating manufacture of certain dyestuffs.

Filter

A New Form of Ultra-Filter. Jl. Am. Chem. Soc., vol. 40, no. 8, Aug. 1918, pp. 1226-1230, 2 figs. Laboratory arrangement consisting essentially of dializer and pervaporator connected by a siphon.

Glass

Electrothermic Methods of Glass Manufacture (Métodos electrotérmicos para la fabricacion del vidrio). Boletín de la Sociedad de Fomento Fabril, year 35, no. 3, Mar. 1918, pp. 161-170, 10 figs. Four types of furnaces: Becker, Brown, Jablochkoff, and Sauvageon.

Scientific Glassware, Morris W. Travers. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 235T-239T. Account of efforts to replace Jena glass in recently established factory at Walthamstow, England.

The Manufacture of Optical Glass, S. A. Hand. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 367-372, 7 figs. History of demand for optical glass and attempts to produce it finally resulting in success at Jena. The solving of the problem in America and its production here.

Laboratory

Equipping a Shop Laboratory. Machy., vol. 24, no. 12, Aug. 1918, pp. 1087-1090, 5 figs. Arrangement of shop laboratory and brief explanation of methods used in analysis of iron and steel.

Nitrates

The Nitrogen Problem in Relation to the War, A. A. Noyes. Sci. Am. Supp., vol. 86, no. 2224, Aug. 17, 1918, pp. 98-99. Resources and methods for making materials required for explosives. Paper before joint meeting of Wash. Acad. of Sciences and Chem. Soc. of Wash. From Jl. of Wash. Acad. of Sciences.

Oil Industry

A New British Oil Industry, E. H. Cunningham Craig, F. M. Perkin, A. G. V. Berry and A. E. Dunstan. Jl. Inst. Petroleum Technologists, vol. 4, no. 15, Apr. 1918, pp. 110-134. Processes to obtain oil by distillation from oil-shales, coal, cannel coals and torbanites, blackband ironstones, lignite and peat.

Make More Gasoline From Petroleum, and Toluol, Too, Louis Bond Cherry. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 319-320. Further details of process described in Jan. 1918 issue.

The Burton Process of Refining Petroleum, Burton. Petroleum Rev., vol. 39, nos. 833 and 834, July 6 and 13, 1918, pp. 5-6 and 31. How it was invented and developed. From address before Am. Chem. Soc.

Oils, Vegetable

On Refining of Niitzu Crude Oil (in Japanese), M. M. Ozuta and Kenzo Sato. Jl. Soc. M. E., Tokyo, vol. 21, no. 53, July 1918.

Peat

Galeine and Houlbert Apparatus for the Distillation of Peat (Appareil, système Galeine et Houlbert, pour la distillation des tourbes). Génie Civil, vol. 73, no. 2, July 13, 1918, pp. 34-35, 2 figs. Scheme and operation.

The Nitrogen Distribution in Peat from Different Depths, C. S. Robinson and E. J. Miller. Jl. Am. Peat Soc., vol. 11, no. 3, July 1918, pp. 158-191, 8 figs. Experimental work: Study of variation in nitrogen partition in peat with depth or age and state of decomposition; comparison of its composition with that of pure proteins; nitrogen availability as determined by the alkaline permanganate method. Reprint of Mich. Agri. College, Tech. Bul. no. 35.

Periodic Table

A Modification of the Periodic Table, Ingo W. D. Hackh. Am. Jl. of Sci., vol. 46, no. 273, Sept. 1918, pp. 481-501, 2 figs. Prediction that no new gas can be discovered from periodic curves obtained by plotting the atomic weights of the known elements by their relative position in the displacement series and by their polar numbers; account for formation of such groups as Fe-Co-Ni, Ra-Rh-Pd, Os-Ir-Pt, and the rare earths; tables showing the close relationship between polar number and isomorphism and the periodicity of the specific gravity; system of the radioactive elements.

Potash

The Estimation of Potash, B. Blount. Chem. News, vol. 117, no. 3052, July 19, 1918, pp. 242-244. Method for the estimation of potash in siliceous rocks, clays, etc., by treatment with hydrofluoric and sulphuric acids.

The Prospects of Founding a Potash Industry in This Country, K. M. Chance, Iron & Coal Trades Rev., vol. 97, no. 2630, July 26, 1918, pp. 86-87. Paper, with discussion, before Soc. of Chem. Industry, Bristol, July 1918.

Rubber

The Object of the Vulcanization Process. India-Rubber Jl., vol. 56, no. 2, July 13, 1918, p. 9. Description of changes brought about.

What the Rubber Chemists Are Doing. India Rubber World, vol. 58, no. 5, Aug. 1, 1918, pp. 654-655. Influence of sodium sulphate, formalin, soda, bisulphite of soda, sodium triosulphate, sodium acetate, and sulphurous acid on the inherent properties; determination of nitrogen; comparative physical tests.

Sulphite

Bisulphite Liquor and Its Constituents, J. Beveridge. Paper, vol. 22, no. 23, Aug. 14, 1918, pp. 11-14. Study of the waste problem and suggestions for the recovery of useful materials.

Sulphite Pulp Manufacture, R. E. Cooper. Paper, vol. 22, no. 25, Aug. 28, 1918, pp. 11-13. Chemistry of process and details of various operations.

Wool

Present Practice in Wool Carbonization, Textile World Jl., vol. 54, no. 6, Aug. 10, 1918, pp. 25-27. Comparison of methods in present practice.

See also Coal Industry (Coking.)

CLAY

(See Brick and Clay)

COAL INDUSTRY

Briquetting

The Briquetting of Lignites, R. A. Ross. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 162-166. Feasibility of meeting fuel requirements in Saskatchewan and Manitoba by utilizing prepared lignites and sub-bituminous coals.

The Briquetting of Western Lignites, R. A. Ross. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 651-654. Present state of the art of producing carbonized lignite briquets; equipment recommended; commercial conditions; procedure. From report to Advisory Council for Scientific and Industrial Research.

Carbonization

Aspects of Low Temperature Carbonization of Coal, E. C. Evans. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 212T-219T. Historical notes; theory of coking process; main differences in oven design for high- and low-temperature carbonization processes; cost of plant. Published also in Colliery Guardian, vol. 116, no. 3304, July 26, 1918, pp. 176-177; Iron & Coal Trades Rev., vol. 97, no. 2630, July 26, 1918, pp. 88-89. Paper before Soc. of Chem. Industry.

Low Temperature Carbonization of Coals, J. L. Stevens. Chem. Eng. & Min. Rev., vol. 10, no. 114, March 1918, pp. 167-170, 2 figs. Mashek process for carbonizing lignite up to 500 deg. cent.; chemistry of coal. (Continuation of serial.)

Coal Deposits

Coal Deposits in the Llapo District (Los yacumientos carboníferos del distrito de Llapo), A. P. Figuerola. Boletín del Cuerpo de Ingenieros de Minas del Perú, no. 89, 24 pages, 1 map. Geography of the carboniferous district of Llapo; coal deposits; quality of the coal.

The Santo Tomas Cannel Coal, Webb Co., Tex. George H. Ashley. Department of the Interior. U. S. Geol. Survey, Bul. 691-I, July 25, 1918, pp. 251-270, 12 figs. General features of the region; physical and chemical properties of the coal; analyses, geologic relations of coal beds; mines and mining.

Coking

An Innovation in the Coke Industry, John L. Gans. Coal Age, vol. 14, no. 6, Aug. 8, 1918, pp. 256-257. Entrance of beehive coke interests into the realm of by-product coke manufacture.

Some Characteristics of American Coals in By-Product Coking Practice, F. W. Sperr. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 133-163, 20 figs. Relations of the by-product coke industry to modern warfare; technical phase of the subject.

The By-Product Coke Oven; Its Products, W. H. Blauvelt. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, p. 392. Coke oven gas; recovery of benzol. Paper before Am. Inst. Min. Engrs.

Labor Situation

The Labor Situation, R. Dawson Hall. Coal Age, vol. 14, no. 8, Aug. 22, 1918, pp. 365-367. General review of labor question in coal mines.

Micro-Chemical Examination

Micro-Chemical Examination of Coal in Relation to its Utilization, J. Lomax. Gas World, vol. 69, no. 1772, July 6, 1918, pp. 18-19. Methods used; results and their significance; carbonization results.

Mining

Can Output Be Increased Scientifically? W. E. Joyce. Coal Age, vol. 14, no. 8, Aug. 22, 1918, pp. 356-357. Writer believes a little modern science would increase coal output.

Coal Mining in Carbonado, Washington, F. G. Jarrett. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 308-312, 7 figs. Description of operations in very rough country.

Methods of Operation, J. F. K. Brown. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 313-315. Conditions influencing methods of coal mining.

Scraper Mining of Thin Bed Anthracite, E. P. Humphrey. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 316-318, 4 figs. Loading coal by means of a V-scraper driven by power.

Wasteful Methods in Mining, R. G. M. Bathgate. Sci. & Art of Min., vol. 28, no. 26, July 27, 1918, pp. 473-475. Conditions in Indian coalfields. From presidential address before Mining and Geological Inst. of India.

War Conditions

The Coal Problem Under War Conditions, H. H. Stoek, Coal Age, vol. 14, no. 9, Aug. 29, 1918, pp. 393-396. Discussion, with suggestions, of present situation.

Washing

A New Method of Separating Slate from Coal, H. M. Chance. Jl. Engrs' Club of Phila., vol. 35-8, no. 165, Aug. 1918, pp. 369-377 and (discussion) 377-378, 6 figs. Survey of apparatus in present use: new methods of effecting separation by means of agitated mixture of sand and water constituting a fluid mass of relatively high specific gravity, in which the coal floats and the slate sinks; application of this principle to other ore-dressing problems. Paper before Engrs.' Club.

Notes on Coal Washing, L. Crawford. Gas World, vol. 69, no. 1172, July 6, 1918, pp. 14-15. Principle of the separation by washing of two particles of equal diameter; table of variations in size or in density necessary to produce appreciable variations in rate of fall, calculated from Rittinger's empirical formula for the limiting velocities of fall of various particles.

The Rhéolaveur, W. Galloway. Proc. South Wales Inst. of Engrs., vol. 34, no. 2, July 19, 1918, pp. 105-112, 7 figs. Description of appliance for washing small coal along a sloping trough in a stream of water. From Bul. de la Société de l'Industrie Minérale.

CONCRETE

(See Cement and Concrete)

CONVEYING

(See Hoisting and Conveying)

DESICCATION

(See Drying)

DOCKS

France

American-Built Docks in France Completed by Pacific Coast Engineers, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 208-216, 22 figs. Illustrated account of building of 4100-ft. structure.

New Orleans

New Orleans Builds Inner Harbor and Navigation Canal. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 304-307, 3 figs. Provides ocean docks and industrial sites on fixed level waterway between Mississippi River and Lake Pontchartrain.

DRYING

Evaporators

Liquid Level Control. Paper Mill, vol. 41, no. 36, Sept. 7, 1918, pp. 22-23 and 46, 2 figs. Device for automatically maintaining liquid levels in evaporators, closed and open tanks, etc., also for draining condensate from heating, drying, cooking and evaporating apparatus.

Low Temperature

Marmier and Canonne Apparatus for drying or Concentrating Liquids at Low Temperatures (Appareil Marmier et Canonne pour la dessiccation ou la concentration des liquides à basse température). Génie Civil, vol. 73, no. 4, July 27, 1918, p. 72, 1 fig. Apparatus operates under reduced pressure down to 37 deg. and is designed for preparation of concentrated serums and organic liquids.

Warm-Air Circulation

Drying by Warm Air Circulation. Eng. Rev., vol. 32, no. 1, July 15, 1918, pp. 14-16, 3 figs. Description of system adopted by the Sturtevant Eng. Co.

ELECTRICAL ENGINEERING

A. C. Motors

Calculation of Performance of Induction Motors Working in Conjunction with Flywheels and Slip Regulators, Herbert Vickers. Elecn. vol. 81, no. 12, July 19, 1918, pp. 248-250. Mathematical treatment of both the continuous and the intermittent slip regulator; also automatic slip regulator and Ward Leonard system.

Control of Induction Motors, C. E. Clewell. Elec. Wld., vol. 72, no. 10, Sept. 7, 1918, pp. 438-441, 12 figs. Fundamental methods outlined and explained; resistance-type starter, auto-transformer method, the use of the choke-coil feature and of so-called preventive resistance; automatic compensator.

The Commercial Application of Synchronous Motors, M. J. McHenry. Elec. News, vol. 27, no. 13, July 1, 1918, pp. 33-36, 2 figs. Attempt to point out principal characteristics which make synchronous motors applicable to certain classes of service, and discussion of industrial use of these motors in relation to central station and its customers.

A. C. Rectifier

An Interesting Alternating Current Rectifier for Charging Accumulators. Wireless World, vol. 6, no. 65, Aug., 1918, pp. 271-272, 1 fig. Device operating by means of a vibration tongue, which, actuated by magnets in circuit with alternating supply, automatically connects line first to one pair of contacts, then the other, in synchronism with supply current.

Armature Heating

Armature Heating in Traction Motors, L. Adler. Elecn. vol., 81, no. 2099, Aug. 9, 1918, pp. 311-312, 5 figs. Abstract of an article in Electrotechnische Zeitschrift, no. 26, 1917.

Bells

Electricity in Mining, L. Fokes, Sci. & Art of Min., vol. 28, no. 26, July 27, 1918, pp. 472-473, 1 fig. Construction, operation and comparison of trembler and single-stroke bells; resistance of bell coils. (Continuation of serial.)

Condensers

Static Condensers, W. B. Taylor. Gen. Elec. Rev., vol. 21, no. 8, Aug., 1918, pp. 565-569, 8 figs. Effect in service of using static condensers on circuits of low power factor, and comparison of this service with that afforded by installing additional feeder copper.

Dynatron

The Dynatron, A. W. Hull. Wireless Age, vol. 5, no. 11, Aug., 1918, pp. 941-951, 12 figs. Formulæ and calculations for the dynatron, a vacuum tube claimed to possess negative electric resistance; applications of the dynatron to radio work. (Continued.)

Electrodeposition

Construction and Operation of Electrolytic Copper Refinery, J. E. McAllister. Eng. & Min. Jl., vol. 106, no. 8, Aug. 24, 1918, pp. 337-341, 1 fig. From first report of Cadanian Munition Resources Commission.

Experiments with the Copper Cyanide Plating Baths, Frank C. Mathers. Metal Indus., vol. 16, no. 8, Aug., 1918, pp. 359-360. Paper before Am. Electro-Chem. Soc., May, 1918.

The Process of Depositing Silver on Glass and China, Howard Pearsall. Brass World, vol. 14, no. 6, June 1918, pp. 157-158. Formulæ and directions.

Electromagnets

The Stroke of an Alternating-Current Electromagnet, A. Thomälen. Elecn., vol. 81, no. 2097, July 26, 1918, pp. 267-268, 6 figs. Abstract of an article in Electrotechnische Zeitschrift, no. 39. A mathematical treatment.

Frictional Electricity

Experiments on Tribo-Electricity, P. E. Shaw. Elecn., vol. 81, no. 10, July 5, 1918, p. 209. Experiments in frictional electricity with solid bodies rubbed together under different physical conditions. Abstract of paper in Proc. of the Royal Soc.

Furnaces

Electric Furnace for Melting Alloys, William H. Easton. Elec. World, vol. 72, no. 7, Aug. 17, 1918, pp. 295-297, 3 figs. Control apparatus must be carefully selected to provide for heavy fluctuation of load; graphic records of power demand when melting nichrome and nickel steel in electric furnaces.

Temperature Uniformity in an Electric Furnace, J. B. Ferguson. Phys. Rev., vol. 12, no. 1, July 1918, pp. 81-94, 9 figs. Discussion of essential conditions for a proper control of temperature distribution and of previous attempts made to secure these conditions; description of a type of horizontal furnace designed for investigation requiring a uniform temperature over the range 620-1190 deg.

Fuses

The Development of 2500-Volt Fuses, Robert Charles Cole. Elec. World, vol. 72, no. 10, Sept. 7, 1918, pp. 436-437. Experimental investigations leading to development of a fuse that is not destroyed by modern high-power short circuits.

Generators

A Direct-Current Generator for Constant Potential at Variable Speed, S. R. Bergman. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 8, pp. 1011-1018, 6 figs. Theory, diagrams of connections, and performance curves of a machine claimed to be self-excited and capable of inherent and instantaneous regulation independent of speed, load and heating.

Generators Employed in Telephone Exchanges. Elec. Rec., vol. 24, no. 3, Sept. 1918, pp. 67-69, 12 figs. Construction and use in modern common-battery telephone exchanges.

High-Speed Turbo-Generators. Practical Engr., vol. 58, no. 1641, Aug. 8, 1918, pp. 64-66, 7 figs. Survey of various methods of construction adopted by manufacturers in design of turbo alternators, and consideration of special characteristics of turbo direct-current machines.

Magnetic Pull in Electric Machines, E. Rosenberg. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1069-1113, 19 figs. Investigates whether in a given machine there is a "critical induction" which gives a higher unbalanced pull than any other induction, and also the permissible deflection of machine parts in connection with the unbalanced pull, and influence of latter on critical speed.

One Way of Raising the Output of an Electric Generator (Sur un moyen de forcer la puissance d'un générateur électrique), Ch. Vallet. L'Industrie Electrique, year 27, no. 626, July 25, 1918, pp. 265-267. Numerical comparison of three systems of cooling an electric machine. (Concluded.)

Harmonics

Higher Harmonics in Polyphase Electric Systems, V. Karapetoff. Elecn., vol. 81, no. 12, July 19, 1918, pp. 250-251. Abstract of paper before Am. Assn. for Advancement of Science.

Inductive Interference

Inductive Effects of Alternating Current Railroads on Communication Circuits, H. S. Warren. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 8, Aug. 1918, pp. 1019-1048. Discussion of inductive interference in general and in electrified railroads, including reference to work of Joint Committee on Inductive Interference in California; description of four important installations of railroad electrification and specific means adopted in each case for preventing interference, with degree of success which has been met with.

Lamps

Lamp Policy of the Fuel Administration. Elec. World, vol. 72, no. 10, Sept. 7, 1918, pp. 457-460. Program of Federal authorities; by eliminating inefficient types of incandescent lamps, is expected to save more than 1,000,000 tons of coal a year.

Lightning Arresters

The Oxide Film Lightning Arrester, Crosby Field. Gen. Elec. Rev., vol. 21, no. 9, Sept., 1918, pp. 597, 6 figs. Description of construction and principle of apparatus.

The Oxide Film Lightning Arrester, Charles P. Steinmetz. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 590-596, 8 figs. Short history of lightning protection of electric systems, ranging from the early communication circuits to the present high-tension, high-capacity transmission lines, employing small air gaps and the aluminum-cell lightning arrester; oscillograph records of tests on the oxide film arrester and discussion of its principle of operation.

Magnetos

Non-Distributor and Multipolar Magnetos, F. I. Hoffman. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 222-223, 16 figs. Discussion of practical possibilities of magnetos designed for use with separate distributors on the engine camshaft—multipolar magnetos delivering up to six sparks per revolution.

Motor Mounting

Notes on Electric Motor Mounting (Note sur le montage des moteurs électriques), A. Curchod. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 145-150, 20 figs. Diagram of connections for each of different types.

Power Factor

Effect of Power-Factor on Central-Station Operation, Will Brown. Elec. Rev., vol. 73, no. 6, Aug. 10, 1918, pp. 199-202, 6 figs. Good voltage regulation and transmission efficiency can be obtained by installing synchronous motors.

Improving Power Factor by Static Condenser. Elec. Rev., vol. 73, no. 9, Aug. 31, 1918, pp. 317-320, 6 figs. Importance of high power-factor; application and sphere of the static condenser, with concrete examples and instances of its use.

Practical Limitations to Power Factor Correction, Ralph Kelly. Elec. Rev., vol. 73, no. 7, Aug. 17, 1918, pp. 243-244, 3 figs. Influence of location of corrective apparatus upon generator and conductor capacity and voltage regulation; proportioning of kilo-volt-amperes and kilowatts; summation of individual power factors.

Radio Engineering

High Power Stations, C. H. Taylor. Wireless Age, vol. 5, no. 11, Aug. 1918, pp. 931-936, 2 figs. Features of the long-distance stations of the Am. Marconi Co. (Continued.)

Present State of Long Distance Radio-Telegraphy and the French Transoceanic Network (L'état actuel de la radiotélégraphie a grande distance et le réseau trans-océanique français), Leon Bouthillon, Génie Civil, vol. 73, no. 5, Aug. 3, 1918, pp. 84-98, 22 figs. Principles of operation of apparatus used and description of processes in large stations.

Progress in Radio Science. Wireless Age, vol. 5, no. 12, Sept. 1918, pp. 979-985, 10 figs. Apparatus devised for rectifying spark gap for high-tension alternating current; details of spark discharge for radio frequency oscillation circuits; x-ray tube wherein length of focus of cathode rays is varied at will of operator.

Progress of Wireless Telephony, E. E. Bucher. Wireless Age, vol. 5, no. 12, Sept. 1918, pp. 1014-1019, 7 figs. Diagram of Espenschied's duplex system and Englund's duplex simultaneous telephone and telegraph system.

Single-Impulse Radiography (Instantaneous): Its Limitations and Possibilities, R. Knox. Jl. Inst. Elec. Engrs., vol. 56, no. 275, June 1918, pp. 352-358. Development of method; comparison of exposures obtained from single-impulse set with mercury dip interrupter and from Siemens impulse outfit; types of apparatus; experiments to show differences obtained when exposing through screen on to plate and through glass on to plate and screen; standardization and technique.

Substations

The Standard Outdoor Substation, J. T Bronson. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 640-651, 22 figs. Requirements of outdoor switching apparatus; outline of types and equipments of outdoor substations.

Telephones

Automatic Telephones at Australia House, London. Elecn., vol. 81, no. 2099, Aug. 9, 1918, pp. 317-318, 2 figs. Description of automatic exchange providing for 200 lines.

Construction and Operation of the Field Telephone and Buzzer, R. D. Greeman. Wireless Age, vol. 5, no. 12, Sept. 1918, pp. 1033-1035, 2 figs. Design of 4000-ft. signal set intended for junior military organizations.

European Telephone Practice, F. W. Scholz. Telephone Engr., vol. 20, nos. 2 and 3, Aug. and Sept. 1918, pp. 83-87, 9 figs., pp. 130-133, 6 figs. (Aug.) Artificial lines; location of defects in underground cables; Castelli apparatus for simultaneous telegraphing and telephoning; French measures to save materials. (Sept.) Chemical and physical theory of lead storage battery; some points on wireless telephony; new telephone selector used in France. (Translations from Revue Générale de l'Electricité and Annales des Telephones.)

Telephone Exchange Transfers and Their Organization, G. C. Baldwin. Jl. Inst. Elec. Engrs., vol. 56, no. 275, June 1918, pp. 390-410, 24 figs. Operations for actual transfer and consideration of engineering processes accompanying work.

Transformers

Current Transformer Ratio and Phase Error by Test Ring Method, H. S. Baker. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp 1173-1183, 6 figs. Method of testing by connecting the primary and secondary of transformer under test respectively in series with the primary and secondary of a special current transformer in which number of turns in secondary coil is varied until primary and secondary ampere turns in special transformer are equal to each other.

Radiator Tank Transformer, H. O. Stephens and A. Paline. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 556-559, 8 figs. Construction rules and details of the latest forms.

Transient Phenomena

Reactance and Short-Circuit Current, R. E. Doherty, Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 562-564, 7 figs. Non-mathematical dissertation of quantitative effect of reactance on short-circuit currents.

Short-Circuit Windings in Direct-Current Solenoids, O. R. Schurig. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 560-562, 2 figs. Application to designs of the phenomenon consisting in the prolongation of time taken by flux to decay after removal of the magnetizing force when a short-circuited winding surrounds a magnetic core

Transmission Lines

Aerial Cable Construction Kinks. Telephony, vol. 75, no. 6, Aug. 10, 1918, pp. 13-15. Methods and devices developed in construction of section between New York and Albany which facilitated rapid placing of cable.

Aerial Line Construction in France, H. G. A. Sansom. Transmitter, vol. 28, no. 3, July 18, 1918, pp. 19-24, 11 figs. Lecture before Victorian Postal Elec. Soc.

Detective and Protective Devices for Electric Cables. Engineer, vol. 126, no. 3267, Aug. 9, 1918, p. 116, 3 figs. Description of protective system for use with test sheath cables.

Resistance and Reactance of Iron Transmission Lines, A. Press. Elecn., vol. 81, no. 2097, July 26, 1918, pp. 275-277, 3 figs. A mathematical treatment.

Voltage Regulators

Voltage Regulator for Combined Lamp and Motor Circuits. Electricity, vol. 32, no. 1445, July 19, 1918, p. 379, 4 figs. Circuits and vector relationship of "stabilizer" developed by the General Electric Co.

ENGINEERING MATERIALS

Babbitt Metal

Babbitt Metals: Conservation of Tin. Elec. Power Club, Bul. no 703, July 1918, p. 1. Composition of two babbitt mixtures used by the General Electric Co. and of two tin alloys used by Westinghouse Elec. & Mfg. Co.

Bluestone

Methods of Quarrying Bluestone. Stone, vol. 39, no. 8, Aug. 1918, pp. 366-368. Characteristic structure of bluestone; difference between bluestone quarrying and other types.

Boiler Plates

A Cause of Failure in Boiler Plates, W. Rosenhain and D. Hanson. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 15, 12 pp., 18 figs. Results of analysis, mechanical tests and microscopic examination of a boiler plate, 1¾-in. thick, 4 ft. 4 in. wide by 11 ft. long, which failed in the last stage of its manufacture.

Brass

Cast Brass, Its Use and Reclamation, R. C. Brown. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 186-187. Suggested scheme to gage service efficiency of the brass account of a railroad.

Bronze (Phosphor)

The Manufacture of Phosphor Bronze, W. W. Rogers. Mach. World, vol. 63, no. 1642, June 21, 1918, p. 297. Composition, method of manufacture, and physical properties. From pamphlet published by Stamford. (Conn.) Rolling Mills Co.

Cadmium

The Allotropy of Cadmium, E. Cohen. Jl. Am. Chem. Soc., vol. 40, no. 8, Aug. 1918, pp. 1149-1156, 3 figs. Aiming to demonstrate that in assumptions made by F. H. Getman (vol. 39, 1917, p. 1806), there are errors which when removed, make his results identical with those obtained by Cohen and Helderman.

Copper

Copper. Circular of the Bureau of Standards, no. 73, June 25, 1918, 103 pp., 25 figs. Sources, metallurgy, refining and uses of commercial grades; possible allotrophy; chemical and physical properties; casting; deoxidation, working, welding, hardening and electrodeposition; heat treatment; effect of impurities on physical properties; definitions and specifications.

Ferrochrome

Ferrochrome, R. M. Keeney. Colo. School of Mines Mag., vol. 8, no. 8, Aug. 1918, pp. 143-147. Process of manufacturing ferrochrome from domestic chromite; recovery and carbon control as affected by grade of ore smelted, grade of product desired, and constituents of the charge.

Flint

Domestic Flint Pebbles and Linings Supplant the Foreign. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, pp. 61-62. Sources of grinding pebbles or substitutes thereof produced in the United States during the last few years.

Paving Blocks

Paving Blocks from Kettle River Quarries. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 64. Appearance of rock, method employed in quarrying it, and result of analysis.

Sand

Tests Uncover Domestic French Sand Substitute, C. P. Karr. Foundry, vol. 66, no. 313, Sept. 1918, pp. 402-403. Thorough investigation conducted with different molding sands shows Zanesville product closely approaching French sand in desirable qualities.

Scrap Metal

Standard of Classification for Old Metals. Steel & Metal Digest, vol. 8, no. 8, Aug. 1918, pp. 479 and 515. Adopted by the Nat. Assn. of Waste Material Dealers.

Silica

Economic Uses of Silica and Its Occurrence in Eastern Canada, Heber Cole. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 306-310. Requirements of silica in glass industry: in manufacture of brick, ferro-silicon, sodium silicate; in pottery and enameling; in paint manufacture; for use as a flux; in producing carborundum; in steel foundries.

Stellite

Notes on Stellite (Quelques observations sur "le stellite"), L. Guillet and H. Godfroid. Revue de Métallurgie, year 15, no. 4, July-Aug. 1918, pp. 339-346, 7 figs. Physical characteristics; structure; chemical analysis; report of author's tests.

Tantiron

Tantiron. Engineering, vol. 106, no. 2745, Aug. 9, 1918, pp. 154-156, 8 figs. Description of a silica iron used for manufacturing chemists' materials, that resists certain corrosive actions.

Textiles

Investigations on Textile Fibers, W. Harrison. Proc. Roy. Soc., vol. 94, no. A 663, July 1, 1918, pp. 460-469, 12 figs. Report of investigations on the effect of stress, moisture and heat; probable cause of the double refraction exhibited by natural fibers and effect of chemical treatment on it; experiments with artificial samples to ascertain in what manner internal stresses can arise in fibers.

Zinc

General Congress of the "Genie Civil." Work done by Section IV (Congrés général du Génie civil. Travaux de la Section IV), Demenge and Maneuvrier. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 157-161. Report on production and utilization of zinc throughout the world. (Continuation of serial.)

New Uses for Zinc, A. P. Cobb. Steel & Iron Digest, vol. 8, no. 8, Aug. 1918, pp. 477-479. Suggestions to dispose of pouring the world's production—greatly increased by the war. Address before Am. Zinc Inst.

See also Aeronautics (Wing Fabrics), Building and Construction (Mill Building), Cement and Concrete, Metallurgy, Railroad Engineering, Steam (Rail Failures); Refractories; Steel and Iron; Testing (Balloon Fabrics.)

FACTORY MANAGEMENT

Cost System

Factory Order and Cost System, W. H. Rohr. Wood-Worker, vol. 37, no. 6, Aug. 1918, pp. 23-25, 7 figs. System designed and operated by Waddell Mfg. Co., Grand Rapids, Mich., manufacturers to order of carvings, turnings, twist work, etc., for interior finish factory trade.

Managership

Under New Management—The Manager, Charles M. Horton. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 113-116. The human qualities of the manager who will succeed in the immediate future.

Mechanical Handling of Materials

Mechanical Material Handling System Reduces Labor and Hauling Costs and Eliminates Waste in Construction of Michigan Road. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 233, 4 figs.

Non-Repetitive Work

Managing Non-Repetitive Work, Norman Howard. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 94-96, 3 figs. How to set times on lathe work in tool making.

Organization

The Spirit of the Organization, William Judson Kibby. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 117-118. How it is created and sustained.

Rate System

Automatic Rate System Is Fair to All, Harold W. Clapp. Elec. Ry. Jl., vol. 52, no. 6, Aug. 10, 1918, pp. 230-231. A year's experience with a service-at-cost franchise in Westerville, Ohio, shows desirability of flexible fares automatically adjusted.

Railway Stores

Railway Stores Methods and Problems, W. H. Jarvis. Ry. Gaz., vol. 29, nos. 2, 3, 4 and 5, July 12, 19, 26, Aug. 2, 1918, pp. 42-44, 75-78, 102-105 and 130-133, 1 fig. Storage and distribution of material; stores fittings; limitation of stock on hand; standard numbering of items; traffic stores requisitions. (Continuation of serial.)

Economic Factors Connected With Storing, H. B. Twyford. Iron Age, vol. 102, no. 7, Aug. 15, 1918, pp. 395-398, 2 figs. Proper quantities of materials and supplies to keep in stock; consideration of maximum and minimum limits.

Snow Removal

Snow Removal, H. Richards, G. T. Donoghue and W. J. Galligan. Jl. West, Soc. Engrs., vol. 23, no. 3, Mar. 1918, pp. 175-191. Reports of Chicago commissioners describing work carried out in their respective districts. Paper before Western Soc. of Engrs. Published also in Contract Rec., vol. 32, no. 36, Sept. 4, 1918, p. 720.

Stocks

Fixing Quantities of Materials in Stock, E. W. Taft. Cassier's Eng. Monthly, vol. 54, no. 1, July 1918, pp. 43-45, 1 fig. A method to determine and periodically to revise maxima and minima of materials stocked by industrial concerns.

See also Industrial Organization.

FORGING

Machine Forging

Machine Forging in Automotive Plants, Automative Industries, vol. 39, no. 8, Aug. 22, 1918, pp. 327-329. Methods employed in the production of upset or annular forgings.

FOUNDRY

Brass Castings

Expansion and Contraction of Brass Castings, P. W. Blair. Metal Indus., vol. 16, no. 8, Aug. 1918, p. 351. Table of contractions.

Cast-Iron Joints

The Manufacture of Metal Beds, Frank A. Stanley. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 427-431, 16 figs. Illustrates and describes methods used in pouring cast-iron joints with work set up in assembling fixtures and with chills for each joint in which parts are gripped and held ready to receive the metal.

Copper Castings

Copper Castings for Electrical Purposes, G. F. Comstock. Brass World, vol. 14, no. 8, Aug. 1918, pp. 229-230. Difficulty of making copper castings of sufficient soundness without decreasing electrical conductivity of the copper.

Cores

Accuracy in Setting Cores, J. V. Hunter. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 439-440, 3 figs. Methods for supporting cores by walls of flask.

Exceptional Gang Core Boxes, J. V. Hunter. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 377-380, 10 figs. Description of a method of greatly increasing number of cores in a gang box; gang boxes of "Cook" type.

Deformation of Steel Castings

The Deformation of Steel Castings, T. Brown. Foundry, vol. 66, no. 313, Sept. 1918, pp. 411-413. From paper before British Foundrymen's Assn.

Die Casting

Aluminum-Bronze Die Casting, H. Rix and H. Whitaker. Metal Ind., vol. 6, no. 8, Aug. 1918, pp. 361-363, 1 fig. The effects of iron and manganese on copper-aluminum alloys. A paper before the British Institute of Metals.

Electric Brass Furnace

A Rocking Electric Brass Furnace, H. W. Gillett and A. E. Rhoads. Brass World, vol. 14, no. 18, Aug. 1918, pp. 217-220, 2 figs. Review of electric brass furnaces and description of one used by Bureau of Mines.

Foundries

How One Steel Foundry Met the Need for Ship and Railway Castings, H. Cole Estep. Foundry, vol. 66, no. 313, Sept. 1918, pp. 415-423, 15 figs. Description of plant of Birdsboro (Pa.) Steel Foundry & Machine Co.

FUELS AND FIRING

Canada

Fuels of Western Canada, James White. Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 155-162. Availability of coal, natural gas, petroleum, electricity, peat and wood in Manitoba, Saskatchewan, Alberta and British Columbia.

Change-Fuel Systems

Auxiliary Steam Plant for Seattle, J. H. Longfellow. Jl. of Electricity, vol. 41, no. 4, Aug. 15, 1918, pp. 152-153. Fuel-oil operation with provision for change over to a coal-fired system in new 100,000-kw. installation.

Coal Selection

Coal and Its Selection, R. June. Brick & Clay Rec., vol. 53, no. 5, Aug. 27, 1918, pp. 389-392, 4 figs. Classification of coals; graphs showing relation of coal to combustion space, influence of moisture, and effect of ash on heating value of Illinois screenings. (Continuation of serial.)

Combustion Losses

Management of the Power Plant, Robert June. Textile World Jl., vol. 54, no. 10, Sept. 7, 1918, pp. 81-87, 2 figs. Combustion losses and how they may be reduced (Third of a series. First two in July 6 and Aug. 24 issues.)

Education of Firemen

Education of Boiler-Room Men Necessary, Edwin A. Hunger. Elec. World, vol. 72, no. 8, Aug. 24, 1918, pp. 344-347. Human element important factor in fuel-conservation efforts; means of fostering interest of firemen; notes on experience of several companies.

Fuel Conservation

Canadian Factory Reduced Coal Bill, B. K. Read. Can. Mfr., vol. 38, no. 9, Sept. 1918, pp. 23-27, 3 figs. Methods adopted and tables of tests on furnaces made by the Dominion Forge & Stamping Co. (To be concluded.)

Coal Conservation in Fact, C. R. Knowles. Contract Rec., vol. 32, no. 36, Sept. 4, 1918, pp. 719-720. Remarks on present waste.

Coal Conservation in New England, Ira N. Hollis. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 89-93. Outlines Massachusetts plan and scheme of organization to reach every factory and reduce and eliminate the present wastage of fuel.

Coal Saving by the Scientific Control of Steam Boiler Plants, D. Brownlie. Engineering, vol. 106, no. 2741, July 12, 1918, pp. 25-27. Average figures for 250 typical plants covering period from 1910 to the present, showing economy that can be effected by adoption of scientific methods in the boiler-house.

Coal Storage Conservation Rules, W. D. Langtry. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 256-257. Oxidation in storage; action of pyrites; spontaneous heating; deterioration; avoiding dangers. Paper before Ill.-Wis. Ice Dealers' Assn.

Conservation of Fuel in California, R. J. C. Wood. Elec. World, vol. 72, no. 8, Aug. 24, 1918, pp. 348-350, 1 fig. By interconnection of systems with different load characteristics one company alone will save nearly a million barrels of fuel oil. Hydroelectric development must continue to meet growing demand for energy.

Fuel Conservation on the Santa Fe, Charles E. Parks. Ry. Rev., vol. 63, no. 4, July 27, 1918, pp. 124-125. Savings of upwards of $2,000,000 made in nine years by the present fuel organization of this road; methods used are explained.

Important Phases of the Fuel Conservation Problem, H. C. Woodbridge. Ry. Age, vol. 65, no. 8, Aug. 23, 1918, pp. 335-336. Suggestions to railway men of all departments regarding economical use of coal. Abstract of paper before Railway Club of Pittsburgh.

Methods for More Efficiently Utilizing Our Fuel Resources. Part XXI. The Coal Fields of the United States, Marius R. Campbell. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 602-619. Detailed statistics of available reserves, present production of each coal region, and map showing all known coal deposits and quality of coal in each region. Abstract from professional paper 100-A, U. S. Geol. Survey, 1917.

Methods for More Efficiently Utilizing Our Fuel Resources, R. H. Fernald. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 542-555, 11 figs. Importance of fuel; statistics of world's coal supply and production; comparative heating values of coal; peat; petroleum and natural gas; conservation.

Reducing Water Waste to Save Coal. Mun. Jl., vol. 43, no. 7, Aug. 17, 1918, pp. 128-129. Figures derived from data obtained in cities of New York; ways by which water waste and leakage can be reduced.

Ways and Means of Saving Coal in the Boiler Room and Shop. Brick & Clay Rec., vol. 53, no. 4, Aug. 13, 1918, pp. 300-301. Recommendations of U. S. Fuel Administration concerning generation and use of power, light and heat.

Gas Fuel

Some Notes on Gas-Firing Boilers, T. M. Hunter. Proc. South Wales Inst. of Engrs., vol. 34, no. 2, July 19, 1918, pp. 127-155, 4 figs. Dry and wet processes of gas cleaning; losses involved in boiler firing by gas; essentials for economical combustion and present methods of burning gas; conclusion drawn from a number of experiments upon a Lancashire boiler; tables showing results following upon the combustion of three typical gases, with different quantities of air dilution.

Kerosene

The Boiling Point of the Paraffins, G. le Bas. Chem. News, vol. 117, no. 3052, July 19, 1918, pp. 241-242. Table showing behavior of compounds in disagreement with Hinrichs-Newmann's rules correlating the boiling point and chemical constitution.

Low-Grade Fuels

Sawdust and Wood Burning. Power Plant Eng., vol. 22, no. 16, Aug. 15, 1918, pp. 647-654, 9 figs. A symposium dealing with furnace designs, conditions to maintain, conveying and storage systems, and value of sawdust and wood as fuels.

The Use of Lignite, Bagasse and Wood Waste for Power Generation and Other Purposes, John B. C. Kershaw. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 121-122, 3 figs. Chemical and physical properties of lignite; power generation from air-dried lignite; briquetting.

Oil Fuel

France and the Use of Petroleum, M. Henri Berenger. Petroleum Rev., vol. 39, nos. 833 and 834, July 6, and 13, 1918, pp. 11-12 and 27-28. Uses for heating engine boilers; liquid fuel in internal-combustion motors (Diesel type); international problem of petroleum and heavy oils. (Continued from vol. 38, p. 406.)

Petroleum from Coal. Petroleum Rev., vol. 39, no. 838, Aug. 10, 1918, p. 87. Report of committee of Technologists' Instn. on production of oil from cannel coal and allied minerals.

Petroleum Under the Microscope, James Scott. Petroleum World, vol. 15, no. 214, July 1918, pp. 282-283, 3 figs. Some unrefined compounds.

Supply of Oil Available from Shales, G. Egloff and J. C. Morrell. Oil & Gas Jl., vol. 17, nos. 11 and 12, Aug. 16 and 23, 1918, pp. 42-46 and 45-48. Treatment in retorts; comparative yields from oil shales; source of oil shale used; experimental methods; distillation analysis, aromatic hydrocarbons; analysis of water resulting from the thermal decomposition of the oil shale; phenols and its derivatives; heterocyclic nitrogen compounds; compounds isolated from oil-shale retorting.

Peat

Peat Occurrences in Illinois. Jl. Am. Peat Soc., vol. 11, no. 3, July 1918, pp. 148-152. Results obtained from the Manito (Mason Co.) experiment field on deep peat where treated plots and untreated strips were cropped. Suggestive treatments for different types of peat soils.

Possibilities of Using Peat as Fuel in Some Places. Jl. Am. Peat Soc., vol. 11, no. 3, July 1918, pp. 140-144. Fuel value and method of preparation. From U. S. Geol. Survey Press Bul., June 19, 1918.

Value of Peat Fuel for the Generation of Steam. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 123-124, 1 fig. Reprint of Bulletin No. 17, Canadian Department of Mines.

Pulverized Fuel

General Utilization of Pulverized Coal, Henry G. Barnhurst. Chem. Eng. & Min. Rev., vol. 10, no. 114, March 1918, pp. 174-177. Paper before Cleveland Eng. Soc.

Smokeless Combustion

Fuel Economy in the Operation of Hand Fired Power Plants. Contract Rec., vol. 32, no. 27, July 3, 1918, pp. 527-531, 4 figs. Chemical analysis of combustion and discussion of the fundamental conditions necessary for complete and smokeless combustion. From Univ. of Ill. Bul.

Smoke Prevention—Coal Saving Suggestions. Paper, vol. 22, no. 25, Aug. 28, 1918, p. 32. Brief outline of suggestions based on long experience of Westinghouse Elec. & Mfg. Co.'s combustion engineers.

Storage

Storage and Handling of Gas Coal, H. H. Stoek. Gas Age, vol. 42, no. 4, Aug. 15, 1918, pp. 145-149. Review of investigations by the Experiment Station of the University of Illinois. (To be continued.)

The Storage of Bituminous Coal, with Reference to its Liability to Spontaneous Combustion in Storage Heaps, Bunkers or Cargo. John H. Anderson, Trans. Inst. Marine Engrs., vol. 30, paper no. 236, June 1918, pp. 81-98 and discussion pp. 98-117. Record of methods employed, which so far have given satisfaction.

The Storage of Bituminous Coal, H. H. Stoek. Power Plant Eng., vol. 22, no. 15, Aug. 1, 1918, pp. 614-616, 3 figs. Abstract of paper before Western Soc. of Engrs.

Waste Heat

Waste Heat Utilization in Cement Works, H. D. Baylor. Ferro-Concrete, vol. 9, no. 12, June 1918, pp. 430-433, 2 figs. Data obtained with a boiler recently installed by the Louisville Cement Co. From paper before Am. Inst. of Chem. Engrs.

See also Chemical Technology (Oil Industry); Coal Industry.

FURNACES

Design

Development of Power from the Standpoint of the Boiler Room, C. F. Hirshfeld. Power, vol. 48, no. 8, Aug. 20, 1918, pp. 284-286, 2 figs. J. E. Alfred Lectures on Engineering Practice, Johns Hopkins University.

Graf Furnace

Graf Gas Consuming Furnace, John Nelson. Iron Age, vol. 102, no. 6, Aug. 8, 1918, p. 359, 1 fig. Air introduced above bridge wall burns gases ordinarily wasted in boilers.

Radiation Furnaces

Superficial Radiation Furnaces (Fours à radiation superficielle), M. P. Negrier. Revue de Métallurgie, year 15, no. 4, July-Aug. 1918, pp. 391-398, 4 figs. Combustion; scheme of burners and mixers; applications of superficial radiation.

Two-Zone Furnace

The Two-Zone Furnace, O. H. Hertel. Popular Engr., vol. 10, no. 1, July 1918, pp. 26-27. Features of the two-zone boiler furnace.

See also Electrical Engineering (Furnaces); Foundry (Electric Brass Furnaces); Steel and Iron (Electric Furnace Melting).

HEATING

Condensation

Returning Condensation in High and Low-Pressure Heating Systems, Charles L. Hubbard. Domestic Eng., vol. 84, no. 7, Aug. 17, 1918, pp. 236-238, 6 figs. Notes on various methods of saving condensation. (Concluded.)

Hot-Water Heating

Expansion of Water in Hot-Water Heating Systems, Howting. Plumbers' Trade Jl., vol. 65, no. 5, Sept. 1, 1918, pp. 277-279, 4 figs. Allowance for expansion in design, construction or installation.

Radiators

Meeting the High Cost of Heating and Ventilating Apparatus, George T. Mott. Heat. & Vent. Mag., vol. 15, no. 8, Aug. 1918, pp. 18-24, 3 figs. Advocates use of wall radiators rather than pipe coils as a matter of economy.

Room Temperature

A Study of Degrees of Discomfort. Heat. & Vent. Mag., vol. 15, no. 8, Aug. 1918, pp. 11-14, 1 fig. Based on temperature comfort tests made at Chicago Normal College by Prof. J. W. Shepherd.

School Buildings

School Building Heating and Ventilation, Samuel R. Lewis. Heat. & Vent. Mag., vol. 15, no. 8, Aug. 1918, pp. 29-35, 4 figs. First article of series.

HOISTING AND CONVEYING

Coal Handling

An Electrically Interlocked Car Haul and Car Feeder, R. P. Hines. Coal Age, vol. 14, no. 7, Aug. 15, 1918, pp. 300-302, 4 figs. A car feeder within the mine and a car haul leading to tipple are so connected electrically that feeder cannot be started until haul is running at normal speed. Both apparatus may be stopped at various points.

Effective System of Coal Handling at Providence, G. K. Jenckes. Gas Age, vol. 42, no. 4, Aug. 15, 1918, p. 158, 1 fig. Extension through use of locomotive crane.

The Britannia Colliery, Pengam, Mon., George Hann. Colliery Guardian, vol. 116, no. 3004, July 26, 1918, pp. 173-175, 2 figs. Illustrated description of plant and equipment; all haulage mechanical. From a paper before South Wales Inst. of Engrs.

Conveyors

Conveyors for Chemical Works, W. H. Atherton. Cassier's Eng. Monthly, vol. 54, no. 1, July 1918, Supp. pp. i-viii, 9 figs. Forms and sizes of oxide and coal conveyors. (Continuation of serial.)

Cranes

Large Navy Floating Crane Made Safe by Regenerative Braking. Elec. Contractor-Dealer, vol. 17, no. 11, Sept. 1918, pp. 100-101, 3 figs. Data of new giant crane said to have lifted a complete tugboat from its berth on the harbor bottom after sinking.

Wall Cranes, E. G. Beck. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 30-31, 4 figs. Mathematical analysis of a frame under specified loading. (Continuation of a serial; preceding article published May 24.)

Elevators

Factors Governing Elevator Drive, C. E. Clewell. Elec. World, vol. 72, no. 8, Aug. 24, 1918, pp. 340-343, 8 figs. Standard safety features usually embodied in control equipment; power requirements of elevators and types of motors suited to the service; direct—and alternating—current elevator motors.

Lift Controllers

Lift Controllers and Controlling Gear for D. C. Lift. Electricity, vol. 32, no. 1445, July 19, 1918, pp. 381-382, 2 figs. Diagrams for car-switch and push-button control systems. (Continuation of serial.)

Marine Railway

Features of an Electrically Operated Marine Railway. Elec. Rev., vol. 73, no. 8, Aug. 24, 1918, pp. 290-292, 3 figs. Installation on Illinois River served by central-station company; boats carried through channel.

Overhead Carriers

Lifeboat Transporting and Lowering Gear. Shipping, vol. 4, no. 7, Aug. 17, 1918, pp. 13-14. Plan and elevations of Ross-Anderson device, consisting of a series of athwartship and fore-and-aft girders carried on columns and forming overhead tracks for trolleys with angular pull bearing.

Notes on the Overhead Koepe Winding Plant at Plenmeller Colliery, Haltwhistle, Northumberland, George Raw. Trans. Inst. Min. Engrs., vol. 55, part 3, July 1918, pp. 170-186, and (discussion), pp. 186-188, 9 figs. Study of operation of plant.

Ropeways

Ropeways in War Time. Telpher. Mech. World, vol. 63, no. 1642, June 21, 1918, pp. 295-296, 9 figs. Explanation of various forms and details of mono-cable and bi-cable lines.

Slag Haulage

Molten Slag Is Hauled by Rail for Making Embankments. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 267-268, 1 fig. Union Railroad at Pittsburgh handles hot materials in ladle cars; fills made in layers prove very substantial.

Trucks, Industrial

Karry-Lode Industrial Trucks, Tractors and Trailers. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 242-243, 3 figs. Trucks employ roller-pinion type of internal drive and are provided with automatic safety switch for use on steamship piers, in railway yards and industrial plants.

Transportation by Power Trucks, Reginald Trautschold. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 97-101, 7 figs. Features of a number of types of special trucks for mechanical handling of materials, with paragraphs on operating costs.

Turntables

Bronze Turntable and Movable Bridge Discs, O. E. Selby. Foundry, vol. 46, no. 312, Aug. 1918, pp. 368-371. Existing specifications discussed and changes recommended to users and brass foundrymen.

Wire Ropes

Wire Ropes, "Kinetics." Practical Engr., vol. 58, no. 1638, July 18, 1918, pp. 28-29, 4 figs. Details of construction of guide, rubber and sinking ropes; winding speeds; factors of safety. (Previous articles published Jan. 3, Feb. 14, Mar. 28, May 2 and June 20.)

See also Transportation (Marine Terminals.)

HYDRAULICS

Bazin Weir Formula

Verification of the Bazin Weir Formula by Hydro-Chemical Gaugings, C. Herschel. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 835-842. Discussion of F. A. Nagler's paper.

Caissons, Concrete

Concrete Caisson of New Type Used in Breakwater. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 258-260, 5 figs. Trapezoidal shape adopted for economy; caissons launched, sunk in place and filled to carry monolithic concrete superstructure.

Cast-Iron Linings of Wells

Special Cast Iron Lining of Two Large Bore Wells, W. H. Maxwell. Eng. & Contracting, vol. 50, no. 7, Aug. 14, 1918, pp. 172-175, 3 figs. Reprint from Water and Engineering, London.

Dams

Facing Leaky Rock-Fill Dam with Timber Planks, George M. Bull. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 229-231, 2 figs. After dam was raised 25 ft., old concrete facing leaked, so 3 rows of creosoted boards were placed on face.

Improving Arch Action in Arch Dams, W. P. Creager and S. H. Woodward. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 871-873. Discussion of L. R. Jorgensen's paper in May issue.

Drainage Channels

Keeping Land Drainage Channels Clear of Growth and Debris in the South, Albert S. Fry. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 263-266. Experiences in removal of willow and other sprouts and maintaining cross-section in two drainage districts; cost data given.

Flood Control

Detention Reservoirs with Spillway Outlets as an Agency in Flood Control, I. E. Honk and K. C. Grant. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 827-834, 3 figs. Discussion of paper by the late H. M. Chittenden.

Friction in Pipes

Water Friction in Pipes and Elbows, E. H. Peterson. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 274-275, 2 figs. Charts showing for different sizes the friction loss in pounds per square inch for various capacities in gallons of water per minute.

Ice Diversion

Ice Diversion, Hydraulic Models, and Hydraulic Similarity, E. E. R. Tratman and B. F. Groat, Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 797-822, 3 figs. Theory of hydraulic models; theory of dynamic similarity; factors of safety. Discussion of B. F. Groat's paper.

Hydroelectric Installations

Hydroelectric Development at Rochester, N. Y. Street Ry. Bul., vol. 18, no. 8, Aug. 1918, pp. 349-351, 7 figs. New 25,000-kva. station of the Railway and Light Co., located in the gorge of the Genesee River.

Junction Development Power Plant. Power, vol. 48, no. 8, Aug. 20, 1918, pp. 258-262 6 figs. Description of 16,500-kw. hydro-electric plant supplying Grand Rapids.

New Plant Added to Michigan System. Elec. World, vol. 72, no. 6, Aug. 10, 1918, pp. 244-248, 6 figs. Description of junction development, the largest hydro-electric plant in Michigan, which is connected with Grand Rapids by 140,000-volt line.

Interesting Small-Capacity Low-Head Hydroelectric Development. Elec. Rev., vol. 73, no. 5, Aug. 3, 1918, pp. 158-160, 5 figs. Description of Geddes plant of 1000-kw. capacity operating under a working head of 15 ft.

The New Copco Development, C. B. Merrick. Jl. of Electricity, vol. 41, no. 4, Aug. 15, 1918, pp. 150-152. Features of construction and operation of hydroelectric plant at Copco, Cal.

The New 300,000-Hp. Hydro Development. Elec. News, vol. 27, no. 13, July 1, 1918, pp. 36-38, 2 figs. Layout of scheme and cross-section of development works at power house of Chippawa plant, Niagara Falls, Ont.

Shutting Off Water

Possiblities of Shutting Off Water, M. A. LaVelle. Gas & Oil Jl., vol. 17, no. 8, July 26, 1918, pp. 48-50. Facts on shutting off bottom water by cement in Kansas and Oklahoma wells; use of cement and importance of excluding water from oil wells.

Silt Deposits

Calculating and Preventing Silt Deposits in Reservoirs, F. Drouhet. Contract Rec., vol. 32, no. 27, July 3, 1918, pp. 522-523. Results obtained in Switzerland from a study of the geographic and hydraulic conditions of water courses.

Storage Reservoirs

Determining the Regulating Effect of a Storage Reservoir, Robert E. Horton. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 455-458, 3 figs. Differential equation for inflow, outflow and storage relations solved by using time interval as independent variable.

Water Works

American Army's Water Works Projects in France Number About Four Hundred, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 434-437, 5 figs. Great range in size and character of supply; several mechanical filters under way; laboratory division controls quality of water.

Construction of Collection and Transmission System for Marin Municipal Water District. Western Eng., vol. 9, no. 9, Sept. 1918, pp. 355-365, 10 figs. Work done in Marin Co., Cal., containing six towns; system consists mainly of two storage reservoirs with a total capacity of 380,000,000 gal.

Effect of War Conditions Upon Construction, Operaton and Maintenance of Water Works. Eng. & Contracting, vol. 50, no. 7, Aug. 14, 1918, pp. 176-177. Findings of special committee of Am. Water Works Assn., with data obtained from about 50 municipally and corporately owned water works in the United States.

Plant Extensions of Public Utilities Financially Considered, John W. Ledoux. Jl. Engrs. Club of Phila., vol. 35-37, no. 164, July 1918, pp. 337-338. Suggestions regarding water-works extensions.

Rural Community Water Supplies, E. L. Miles, Jl. Eng. Inst. of Canada, vol. 1, no. 4, Aug. 1918, pp. 145-150, 3 figs. Account of author's observations while acting as government inspector of water supplies in Province of Saskatchewan. Also published in Can. Engr., vol. 35, no. 7, Aug. 15, 1918, pp. 161-164 and 166, 3 figs. Before Second General Meeting of Eng. Inst. of Can.

The Water Supply of New York. Engineer, vol. 126, 3267, Aug. 9, 1918, pp. 109-111, 8 figs. Engineering features of dams, tunnels, aqueducts, etc.

War Burdens of Water-Works of United States Increase. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 308-312, 3 figs. From a report to executive committee of Am. Water-Works Assn.

Water-Works Operation. Min. Jl., vol. 45, nos. 6. and 7, Aug. 10 and 17, 1918, pp. 107-108 and 111 and 129-130. Repairing leaks and breaks in water mains and underground appurtenances; preventing recurrence of leaks; leaking valves.

INDUSTRIAL ORGANIZATION

Cost of Service the Chief Factor in Rate Regulation, William G. Raymond. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 451-454. Rational "fair value" held to be sum of interest on investment and profit on operating expenses, capitalized at "fair return" rate.

Elimination of Idleness by Systematic Study, Charles Whiting Baker. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 450-451. Graphic chart shows significance of increase in efficiency by reducing machinery idleness among industries.

Organization and Coöperation, David J. Champion. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 229-231. Trade organization necessary for progress; closer coöperation among boiler manufacturers badly needed. Address before annual convention, Boiler Manufacturers' Assn.

Capital Charges

Discussion of Mr. David M. Mowat's Paper on "Capital Charges Considered along with Current Expenses." Trans. Inst. Min. Engrs., vol. 55, part 3, July 1918, pp. 190-195. Paper appeared in Trans. 1917-1918, vol. 54, p. 317 and vol. 55, pp. 54-133.

City War Organization

Milwaukee's Organization for War, Willits Pollock. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 121-123. Trying out general staff idea in an industrial city.

Demobilization

Contract Prices During Demobilization, W. P. Digby. Elecn., vol. 81, no. 2099, Aug. 9, 1918, pp. 308-309, 4 figs. Abstract of paper before Inst. Elec. Engrs. Experience of previous wars: increase in wages and prices of materials in the past few years.

Depreciation

Some Pitfalls in Regulating Depreciation, John Bauer. Elec. Ry. Jl., vol. 52, no. 8, Aug. 24, 1918, pp. 326-328.

See also Factory Management.

INTERNAL-COMBUSTION ENGINEERING

Carburetors

Four New Carburetion Devices. Motor Age, vol. 34, no. 6, Aug. 8, 1918, pp. 40-42, 6 figs. Universal Airgas, Manifold, Hodges and Kerosene Equipment, with their characteristics.

The Carburettor. Technicus. Auto, vol. 33, no. 30, July 26, 1918, pp. 532-534, 2 figs. Technical study of the factors determining its successful operation. (Concluded from p. 516.)

Diesel Engines

Operation of Submarine Diesel Engines, F. C. Sherman. Gas Eng., vol. 20, no. 9, Sept. 1918, pp. 425-429. Causes of troubles and their elimination.

Random Remarks on Modern Marine Diesel-Engines, H. R. Setz. **Motorship,** vol. 3, no. 9, Sept. 1918, pp. 10-12, 7 figs. Effect of length of stroke on efficiency; distinction between mechanical and physical strokes; technical details of the new Tosi merchant-marine Diesel engine.

Heavy-Oil Engines

The Heavy-Oil Engine, Charles E. Lucke. Engineer, vol. 126, no. 3265, July 26, 1918, pp. 80-83. Its application; tendencies in design. From paper before Engrs. Club of Phila., Jan. 1918, and printed in Journal of Club, June, 1918.

High-Speed Engines

High-Speed Internal Combustion Engines, Harry R. Ricardo. Mech. World, vols. 63 and 64, nos. 1646 and 1647, June 14 and July 26, 1918, p. 284 and pp. 45-46, 1 fig. Features of high-speed engine design. From paper before North-East Coast Inst. of Engrs. and Shipbuilders. (To be continued.)

Ignition System

A Simple Dual Ignition System, G. F. Crouch. Motor Boat, vol. 15, no. 15, Aug. 10, 1918, pp. 22-23, 2 figs. Switch invented by E. S. Brainard, Sacramento, Cal., to use battery and coil with high-tension magneto.

Individual Types

Buda Model "H T U" Engine. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 282-283, 5 figs. Model with detachable cylinder head, force-feed lubrication, special crankcase construction, heavier flywheel for tractor use, and vaporizing manifold for burning kerosene, designed for truck and tractor service.

Kahlenburg Heavy-Oil Engine. Motorship, vol. 3, no. 9, Sept. 1918, p. 13, 1 fig. General features of motor of the surface-ignition class built at Two Rivers, Wis.

The Possibilities of the Hvid Engine. Nat. Gas Engine Assn. Bul., vol. 4, no. 2, Sept. 1918, pp. 6-17. Discussion of paper by E. B. Blakely, published in Aug. Bulletin.

Knocking

Knocking in Gas Engines. Practical Engr., vol. 58, no. 1538, July 18, 1918, pp. 31-32. Significance and possible causes.

Multiple Valves

Increasing the Engine's Volumetric Efficiency, Morris A. Hill. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 295-297, 5 figs. Further comment on multiple valves, and designs which aim to give multiple-valve effect without its numerous parts. (Fifth of series.)

Pulverizers

Oil-Engine Sprayers or Pulverizers, A. H. Goldingham and C. T. O'Brien. Motorship, vol. 3, no. 9, Sept. 1918, pp. 19-20, 4 figs. Description of four types. (Continued.)

Sub-Pistons

Gile Engine Employs Sub-Piston. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, pp. 229 and 238, 2 figs. Longitudinal and cross-sections of engine designed to work on two-stroke principle, with piston-controlled port for inlet and a poppet valve in the head for exhaust.

Turbines

Internal Combustion Turbines. Practical Engr., vol. 58, no. 1639, July 25, 1918, pp. 40-42, 10 figs. Some types of gas turbines.

See also Aeronautics (Engine Pistons, Engine Temperature Control, Engines, Mufflers); Motor-Car Engineering (Piston Displacement); Producer Gas and Gas Producers.

IRON

(See Steel and Iron)

LABOR

Bethlehem Award

Labor Board's Award in Bethlehem Case. Iron Age, vol. 102, no. 6, Aug. 8, 1918, pp. 326-327. Text of finding in case of machinists and electrical workers vs. Bethlehem Steel Co.

Business Management

Significant Changes in Business Management. Am. Mach., vol. 49, no. 5, Aug. 1, 1918, pp. 191-193. Suggestions regarding policy to meet changes in relations between capital and labor.

Housing

Company Residences for Railroad Employees, C. B. & Q. R. R. Ry. Rev., vol. 63, no. 6, Aug. 10, 1918, pp. 197-200, 6 figs. Description with plans of cottages and rooming houses.

Labor Costs

Report on Estimating Labor Costs. Elec. Rev., vol. 73, no. 4, July 27, 1918, pp. 125-131, 7 figs. Compiled by the Electrical Estimators' Assn. of Chicago and presented at the Cleveland Convention of the National Assn. of Electrical Contractors and Dealers.

Negroes

Negroes a Source of Industrial Labor, Dwight Thompson Farnham. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 123-129, 10 figs. Experiences of author with this type of labor.

Piecework Rates

Determining of Piecework Rates from Charts, Otto M. Burkhardt. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 383-387, 6 charts. A simple method of figuring piecework prices by means of charts when the necessary time elements are known.

Railroad Employees

Classification, Working Conditions and Wages of Mechanical Department Employees. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 154-157. Supplement no. 4 to general order no. 27, Director General of Railroads.

Training

Intensive Training in an Aircraft Plant, Frank L. Glynn. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, 7 figs. Curtiss Co.'s school has capacity of 200 to 300 operatives per week. Women develop skill after short instruction period.

Steel Plant Educates Foreign Employees. Blast Burnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 384-385. Youngstown Sheet & Tube Co. establishes system of free schools primarily for educating and Americanizing foreign-born employees in all parts of the mills.

The Training of Engineers, E. J. Silcock. Can Engr., vol. 35, nos. 6 and 7, Aug. 8 and 15, 1918, pp. 138-140 and p. 150. Scope of education of civil engineer and amount of specialization necessary for those who intend to practice as water-works engineers. Paper before Inst. Water Engrs., England. Published also in Surveyor, vol. 54, no. 1381, July 5, 1918, pp. 3-4.

Training Metallurgists in Schools and Metallurgical Works, H. C. H. Carpenter. Can. Min. Jl., vol. 39, no. 14, July 15, 1918, pp. 246-248. Extracts from presidential address, Inst. of Metals, London, March 1918.

Training 150 Operators Per Week. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 277-280. How the vestibule school of Remington Arms Company is meeting the demand for skilled workers of both sexes; how operatives are routed through plant.

Women

Employment of Women in Munition Factories. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 223-238. Records of several plants presented by members of Institute.

The Efficient Utilization of Labor in Engineering Factories, B. H. Morgan. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 239-265. Special reference to women's work.

Women in Railway Work. Ry. Rev., vol. 63, no. 4, July 27, 1918, pp. 122-123, 4 figs. Women employed by railways in various capacities.

See also Coal Industry (Labor Situation.)

LIGHTING (ILLUMINATION)

Automobile Plants

Improved Lighting of Automobile Manufacturing Plants, F. H. Bernhard. Elec. Rev., vol. 73, no. 6, Aug. 10, 1918, pp. 205-211, 12 figs. Advisability of utilizing latest lighting developments; features that need special improvement.

Edison Lamps

Edison Mazda Lamps for Protective Lighting. Edison Lamp Wks. of Gen. Elec. Co., Bul. no. 43,412, July 1918, pp. 1-14, 26 figs. Application of contrast to protective lighting; glare; available apparatus; sketches illustrating arrangement in various systems.

Illumination

Fundamentals of Illumination Design, Ward Harrison. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 535-541, 10 figs. Solution of problems covering the lighting requirements of a large general office, the main floor of a clothing store, a furniture factory, and an industrial plant manufacturing tools and other similar metal parts. (Concluded.)

Indirect Lighting

Illumination, Harold W. Brown. Elec. Contractor-Dealer, vol. 17, no. 11, Sept. 1918, pp. 86-91, 23 figs. Applications of indirect lighting to hospitals, churches, reading rooms, stores and houses.

Laws on Lighting

Laws Regulating Insufficient Lighting, Chesla C. Sherlock. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 381-382. Résumé of some court findings.

Printing Plants

The Lighting of Printing and Book-Binding Plants, F. H. Bernhard. Elec. Rev., vol. 73, no. 8, Aug. 24, 1918, pp. 279-286, 11 figs. Importance of best possible lighting to printer; general features of lighting problem and suggestions for effective illumination of principal departments.

War Conservation

Lighting Curtailment, Preston S. Miller. Jl. Engrs.' Club, Phila., vol. 35-8, no. 165, Aug. 1918, pp. 381-391 and (discussion) pp. 391-399, 2 figs. Considers that since coal used in production of electric light is less than 2 per cent of total output of country and standards of illumination intensity before the war were in general too low, it is practicable to effect much larger savings by other methods with less disadvantage to the public.

War Conservation of Power and Light, Chas. E. Stuart. Jl. Engrs.' Club, Phila.,

vol. 35-8, no. 165, Aug. 1918, pp. 400-403. Practical scheme of operations of power and light division of U. S. Fuel Administration.

See also Electrical Engineering (Lamps.)

LUBRICATION

Selection

Important Factors in Choosing Lubrichants, F. H. Conradson. Petroleum Rev., vol. 39, no. 838, Aug. 10, 1918, pp. 85-86. Lubrication problems in connection with new designs, service conditions and requirements.

See also Air Machinery (Lubrication); Steam Engineering (Lubrication, Engine Cylinder); Testing and Measurements (Lubricants Testing, Viscosimeter.)

MACHINE PARTS

Ball Bearings

Ball Bearings for Machine Shop Equipment, Edward K. Hammond. Machy., vol. 94, no. 12, Aug. 1918, pp. 1097-1103, 6 figs. Discusses the advantages of ball bearings, their construction, lubrication, design of mountings and felt packings.

Ball-Races in Machine Tools, J. Horner. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 26-27, 6 figs. Application of Skefko ball bearings to various machines. (Continuation of a serial; preceding article published June 28.)

Belts

Belts for Driving High-Speed Cutterheads. Wood-Worker, vol. 37, no. 6, Aug. 1918, pp. 40-41, 2 figs. Suggestions recommending light double belts for this service.

Cam Profiles

Cam Profiles (I), W. K. Wilson. Mech. World, vol. 64, no. 1647, July 26, 1918, pp. 43-44, 3 figs. Investigation of effect a modification of cam profile can produce upon inertia pressure to which valve gear is subject. (To be continued.)

Gears

A Note on Spiral Gears. Mech. World, vol. 64, no. 1647, July 26, 1918, p. 39, 1 fig. Suggestions in calculation of engine gears.

Gear Standardization, B. F. Waterman. Machy. Market, nos. 926 and 927, Aug. 2 and 9, 1918, pp. 17 and 19. General aspect of the problem; application of standards, worm making; inspection committee. Abstract of paper before Am. Gear Mfrs.' Assn.

Strength of Spiral Type Bevel Gears, Reginald Trautschold. Mach., vol. 24, no. 12, Aug. 1918, pp. 1111-1115, 2 figs. Formulæ for determining strength of spiral type bevel gears.

Thermal Refinement of Gear Blanks, C. R. Poole. Page's Eng. Weekly, vol. 33, no. 724, July 26, 1918, p. 41. Difference between carbonized and heat-treated types of gears. Paper before Am. Gear Mfrs.' Assn.

MACHINE SHOP

Balancing

Dynamic Balancing of Rotating Sections, Carl Hering. Elec. World, vol. 72, no. 9, Aug. 31, 1918, pp. 389-390, 1 fig. Dynamic balancing additional to static balance; rational unit for expressing and measuring the tolerance allowed.

Blacksmith Shop

The Engineer's Smith, Joseph Horner. Mech. World, vol. 63, no. 1642, June 21, 1918, p. 294, 2 figs. Character of the layout, and nature of the practice of present day shops. (To be continued.)

Bolt Making

Bolt Manufacture in Railway Shops, M. H. Williams. Ry. Mech., Eng., vol. 92, no. 8, Aug. 1918, pp. 465-470, 7 figs. Consideration of methods and tools necessary for rapid production.

Chatter Marks

Elimination of Chatter Marks from Machined Work. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 349-354, 11 figs. Some of the main causes of chatter marks and means taken to eliminate them.

Crank Repairs

Crank Repairs, C. E. Anderson. Power Plant Eng., vol. 22, no. 16, Aug. 15, 1918, pp. 667-669, 4 figs. Difficulties encountered and remedies employed.

Cutting of Metal

Cutting Heavy Forging Ingots, W. B. Perdue. Jl. Acetylene Welding, vol. 2, no. 2, Aug. 1918, pp. 80-86, 2 figs. Methods used by Judson Mfg. Co., Oakland, Cal.

The Cutting of Cast Iron with Oxygen. Acetylene & Welding Jl., vol. 15, no. 177, June 1918, pp. 106-109, 2 figs. Table of data and results from a series of tests. (Concluded.)

The Cutting of Iron and Steel by Oxygen, M. R. Amedeo. (Translated from original French by D. Richardson). Acetylene & Welding Jl., vol. 15, no. 177, June 1918, pp. 102-103, 3 figs. Microphotographs showing decarburization of metal with central jet oxy-acetylene cutting blowpipe. (Continuation of serial.)

Drilling-Machine Work

Unusual Operations on Drilling Machines, Edward K. Hammond. Machy., vol. 24, no. 12, Aug. 1918, pp. 1091-1093, 6 figs. Use of drilling machines for milling, broaching, driving studs and assembling.

Foil Manufacture

The Manufacture of Tin and Lead Foil, L. J. Krom. Metal Indus., vol. 16, no. 8, Aug. 1918, pp. 352-354, 7 figs. Brief illustrated description of process.

Friction Clutch

Manufacturing the Johnson Friction Clutch. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 263-266, 11 figs. Details of manufacturing operations.

Gages

Flush-Pin Versus Limit Gages, Albert H. Dowd. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 283-284, 5 figs. Describes several types of flush-pin gages both for work and inspection and gives examples of their use.

Indicating Fixtures for the Gaging of Automobile Parts, Albert A. Dowd. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 299-302, 5 figs. Description of several indicating gages.

Surface Gage with Fine Adjustments, J. G. J. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 27, 1 fig. Sketch of a surface gage with adjustment for height.

Galvanizing Sheets

Modern Practice in Galvanizing Sheets, Clement F. Poppleton. Iron Age, vol. 102, no. 8, Aug. 22, 1918, pp. 433-436, 2 figs. Methods of constructing and operating galvanizing pots; preparation of material and costs; some hitherto unpublished facts.

Gas-Engine Construction

Gas Engine Work on the Pacific Coast, Frank A. Stanley. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 343-347, 17 figs. Description of certain operations in making marine and stationary engines.

Machining Pistons, Flywheels and Cylinders of Gasoline Engines, M. E. Hoag. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 443-444, 5 figs. Work of Potter & Johnson automatics with special fixtures and tooling.

Heat Treatment

Effect of Mass on Heat Treatment, E. F. Law. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 16, 15 pp., 17 figs. Report of experiments: Sets of heating and cooling curves of 18-in. cubes, each weighing 14½ cwts., heated to a temperature of 1650 deg. fahr. and allowed to remain in the furnace for 4½ hr.; microphotographs of sections cut from test-pieces representing the steel cube from outside to center; survey of results obtained by other investigators; conclusions and further experiments on 12-in. cubes.

Electric Furnace for Heat Treating Small Airplane Parts, Dwight D. Miller. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 373-376, 2 figs. Description of electric furnace for heat-treating metal parts and operations involved.

Electric Treatment of Airplane Forgings, Dwight D. Miller. Iron Age, vol. 102, no. 7, Aug. 15, 1918, pp. 381-385, 4 figs. Details of Bailey furnace for heat-treating axle forgings at plant of Ingalls-Shepard Forging Co.

Time Effect in Tempering Steel, A. E. Bellis. Ry. Jl., vol. 24, no. 8, Aug. 1918, pp. 27-28. Report of tests made on rifle-barrel steel. Abstract of A. I. M. E. paper.

Hobbing

Charts Giving Time Required to Hob Spur Gears, V. P. Rumley. Machy., vol. 24, no. 12, Aug. 1918, pp. 1085-1086, 2 charts.

Hobs and Hobbing, F. G. Hoffman. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 27-28. Proposed ideal system of cutting gears developed from a study of the various methods in use at present. Am. Gear Mfrs. Assn. paper.

Reclamation Work

Connecticut Company Centralizes Reclamation Work at New Haven. Elec. Ry. Jl., vol. 52, no. 9, Aug. 31, 1918, pp. 364-367, 14 figs. By segregating heavy repairs, manufacturing operations and reclaiming of damaged equipment this company has achieved substantial economies.

Rubber Insulators

Moulds for Hard Rubber Insulators, Effero. India-Rubber Jl., vol. 56, nos. 1, 2 and 3, July 6, 13 and 20, 1918, pp. 9-10, 33-34, 16 figs, and 57-61, 8 figs. Design features of the rotating distributor arm and stationary carbon holder for the high tension magneto. (Serial.)

Sand Blast

Sand-Blast Operation, D. Evans. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 32, 4 figs. Pressure required for cleaning steel; description of four types of sand-blast equipment. (To be continued.)

Screw Cutting

Cutting and Verifying Accurate Screw Threads (La taille et la correction des vis de précision), Génie Civil, vol. 73, no. 5, Aug. 3, 1918, pp. 81-84, 10 figs. Bryant Symons screw-cutting lathe.

Screw-Cutting Simply Explained for Munition Workers, G. Gentry. Model Engr. & Elecn., vol. 39, no. 899, July 18, 1918, pp. 37-38. Calculating wheels for cutting metric threads on metric lathes and on English lathes. (Continuation of serial.)

Shafting Brackets

Hanger and Bracket Fixings for Rolled-Steel Joists, F. R. Parsons. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 31, 9 figs. Suggested methods of attaching shafting brackets, hangers, bearings, idler or gallows pulleys to rolled-steel joists, in such a manner as will permit a certain amount of latitude of adjustment in order to bring them and the shafting into alignment.

Welding

A. C. Arc Welding and Cutting. Automotive Industries, vol. 39, no. 6, Aug. 8, 1918, p. 241, 1 fig. Light-weight machine of Electric Arc Cutting & Welding Co., Newark, N. J., consisting of a special transformer with no moving parts.

Bibliography of Electric Welding, 1918-1914, William F. Jacob. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 652-658. Includes references to theory, various uses, methods of application, and costs.

Boiler Repairs by Electric Welding, R. S. Kennedy. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 225-227. Development of arc-welding process; description of equipment; examples of application of process to boiler repairs. From paper before Inst. of Marine Engrs., London.

Electric Arc Welding, A. M. Candy. Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1159-1171, 21 figs. History of process; present practice; manipulation of arc and weld; carbon vs. metallic electrodes.

My Method of Welding with the Electric Arc and Work Which I Have Done, E. D. Johnson. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 219-222, 14 figs. Suggestions from author's nine years' experience.

The Autogenous Welding of Lead (Lead Burning), P. Rosenberg. Acetylene & Welding Jl., vol. 15, no. 177, June 1918, pp. 100-101, 5 figs. History of the manufacture of sulphuric acid and of autogenous welding. Enumeration of four processes for lead: hydrogen and air, hydrogen and oxygen, acetylene and air, acetylene and oxygen. (To be continued.)

The Relation to Welding Problems of the Properties of Iron and Steel and Their Heat Treatment. Jl. Acetylene Welding, vol. 2, no. 2, Aug. 1918, pp. 74-76. Difficulties in welding cast iron and suggested remedies to overcome them. (Continuation of serial.)

Welded Seams and Connections Correct Faults in Big Converters. Jl. Acetylene Welding, vol. 2, no. 2, Aug. 1918, pp. 70-73, 9 figs. Details of operation in welding a flange to a cotton converter.

Welding Methods at Columbus Shop. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 473-474, 4 figs. Carbon- and metallic-arc welding both used; special building erected for welding.

Welding Truck Side Frames, Bolsters and Arch Bars. Ry. Jl., vol. 24, no. 8, Aug. 1918, pp. 23-24. Committee report before M. C. B. Assn.

See also Aeronautics (Metal Fittings.)

MACHINERY

(See Metal-Working Machines, Woodworking Machines.)

MARINE ENGINEERING

Concrete Ships

Concrete Barges, Louis L. Brown. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 450-452, 8 figs. Brief description of design, method of construction, materials used, method of waterproofing and launching. From a paper before Am. Concrete Inst., June 1918.

Concrete Barges Designed for New York State Barge Canal. Eng. News-Rec., vol. 81, no. 6, Aug. 8, 1918, pp. 271-272, 4 figs. Shipping Board prepares plans for 500-ton towboats to be operated by Federal Railroad Administration.

Concrete Ship of 3500 Tons Deadweight Designed by Emergency Fleet Corporation. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 446-449, 9 figs. Conclusions of the Concrete Ship Department; details of the standard ship.

Design and Construction of Self-Propelled Reinforced Concrete Seagoing Cargo Steamers Now Building in Great Britain, T. G. Owens Thurston. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 455-464, 15 figs. Paper before Inst. of Naval Architects, London, March 1918.

Progress in the Application of Concrete to Barge and Shipbuilding, J. E. Freeman. Jl. West. Soc. Engrs., vol. 23, no. 3, Mar. 1918, pp. 205-220. Review of progress in concrete-boat building from its earliest inception; discussion of various problems entering into application of reinforced concrete to such construction.

Reinforced Concrete Tugs (Les remorqueurs en béton armé), G. Espitallier. Génie Civil, vol. 73, no. 4, July 27, 1918, pp. 61-64, 14 figs. Type Peinard-Considère, Caquot & Co.; principles for computation of dimensions; protection; prevention of leaks.

Seagoing Reinforced Concrete Ships Sogaaende Jaernbetonskine), H. Glysing. Ingenioren, vol. 27, no. 58, July 20, 1918, pp. 413-415.

The Building of a Concrete Barge, L. L. Livingston. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 629-630. Method recently employed at New York. Read before the Am. Concrete Inst.

The Building of Concrete Ships. Contract Rec., vol. 32, no. 33, Aug. 14, 1918, pp. 645-647. Am. Concrete Inst. paper.

The Design of Concrete Ships, H. Devereux. Western Eng., vol. 9, no. 9, Sept. 1918, pp. 343-358, 27 figs. Formulæ and curves.

Control Mechanism

Mechanical Interlock Between Telegraph and Main Engine Control Lever. Shipbuilding and Shipping Rec., vol. 12, no. 4, July 25, 1918, pp. 83-84, 1 fig. Mechanism to prevent the engine-control lever being moved in contradiction to the telegraph indications.

Corrosion

Corrosion of Ships. Nautical Gaz., vol. 94, no. 8, Aug. 24, 1918, p. 89. Causes and protectors. From Liverpool Jl. of Commerce.

Deadrise Cruisers

Model Experiments on Express Cruisers of Deadrise Type, T. A. Gamon. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 473-476, 7 figs. For high-speed length ratio, deadrise type proves superior to round bilge model; resistance of appendages investigated.

Electric Fittings

Construction and Uses of Marine Electrical Fittings. Elec. Rec., vol. 24, no. 3, Sept. 1918, pp. 61-66, 25 figs. Details of fittings and illustrations of typical, special and standardized types.

Furness Company's Shipyard

A New Furness Shipyard. Engineering, vol. 106, no. 2743, July 26, 1918, p. 82, 9 figs. Short notice of new enterprise, with illustrations of the work in progress. Also published in Engineer, vol. 26, no. 3265, July 26, 1918, pp. 73-74, 7 figs.

Hog Island

A Record of Achievements at Hog Island, W. H. Blood, Jr. Elec. Rev., vol. 73, no. 5, Aug. 3, 1918, pp. 155-157, 4 figs. Statistics on the work in progress and results already secured.

Launching

End-Launching of Vessel in Narrow Stream, Max Hausen. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 469-470, 1 fig. Vessel started down ways at high velocity and brought to a standstill at end of ways by means of a brake.

Motorships

Novel Large Britsh "Diesel"-Driven Tanker. Motorship, vol. 3, no. 9, Sept. 1918, pp. 14-15, 2 figs. General dimensions of Santa Margharita, a motorship of 11,000 tons d-w-c., fitted with solid-injection Vickers oil engines of 2500 b.hp. and with auxiliary motors of 1150 b.hp.

The Australian Motorship "Cethana." Motorship, vol. 3, no. 9, Sept. 1918, p. 15. Details of acceptance trials of American-built Diesel-engined wooden merchant vessel of the single well-deck type.

Trials of M. S. "Alabama." Motorship, vol. 3, no 9, Sept. 1918, p. 21. Speed tests of new 1000-b.hp. Diesel-driven vessel of 4000 tons deadweight capacity.

Repairs

Emergency Repairs to a Battleship. Shipbuilding & Shipping Rec., vol. 12, no. 5, Aug. 1, 1918, pp. 113-115. Details of work involved in substitution by the engine-room staff of the "Arkansas," of an electric motor for the wrecked starboard main circulating pump.

Reversing Rudders

Reversing and Control Rudder. The Rudder, vol. 34, no. 9, Sept. 1918, pp. 436-437, 7 figs. Experiments with a 25-ft. power boat showing the possibility of eliminating reversing turbines from turbine-propelled ships.

Rivetless Ship

See Welded Ships, below.

Submarines

Propelling Machinery for Submarine Boats (in Japanese), Genjiro Hamabe. Jl. Soc. M. E., Tokyo, vol. 21, no. 53, July 1918.

Tuckahoe

The Building of the "Tuckahoe," E. A. Suverkrop. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 278-281, 10 figs. Record of the progress in building this 5500-ton collier in 27 days.

Turbo-Electric Propulsion

Electric Propulsion of Ships, Eskil Berg. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 477-479. Results obtained with electric drive on the "Jupiter"; installations for battleships and cruisers.

The Ljungström Turbo-Electric System of Ship Propulsion. Engineering, vol. 106, no. 2741, July 12, 1918, pp. 30-31, 16 figs. Description of the radial-flow steam turbines built for S. S. Wulsty Castle.

Welded Ships

An Electrically Welded Barge. Engineering, vol. 106, no. 2745, Aug. 9, 1918, pp. 142, 2 figs. Description of experimental rivetless ship constructed in Great Britain.

Britain's First Rivetless Ship. Nautical Gaz., vol. 94, no. 7, Aug. 17, 1918, p. 79. Discussion of possibilities and claimed disadvantages of the electric welding process.

Electrically-Welded Barge. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 122-123, 2 figs. Description of 275-ton rivetless barge constructed in Great Britain.

Electrically-Welded Ships. Elecn., vol. 81, no. 2099, Aug. 9, 1918, pp. 319-320, 1 fig. Description of experimental 275-ton rivetless barge constructed in Great Britain.

See also Building and Construction (Shipyard); Hoisting and Conveying (Overhead Carriers); Internal-Combustion Engineering (Diesel Engines.)

MATHEMATICS

Closed Curves

On Closed Curves Described by a Spherical Pendulum. Arnold Emch. Proc. Nat. Acad. of Science, vol. 4, no. 8, Aug. 1918, pp. 218-221. Results of analytical investigation of properties of these curves.

Hypergeometric Functions

The Practical Importance of the Confluent Hypergeometric Function. H. A. Webb and J. R. Airey. Lond., Edinburgh & Dublin. Phil. Mag., vol. 36, no. 211, July 1918, pp. 129-144, 10 figs. Tables and graph designs, differential equations solvable by means of these, and properties of the functions used in constructing the tables.

Single-Side Surface

A Surface Having Only a Single Side, C. Hering. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 233-241, 13 figs. Equation and analytical investigation of the properties of a surface generated by a line moving along a circle, always remaining in planes passing through the axis of the circle and simultaneously revolving around the circle as its axis at half the angular rate of its movement along the circle.

Theory of Numbers

Arithmetical Theory of Certain Hurwitzian Continued Fractions, D. N. Lehmer. Proc. Nat. Acad. of Sci., vol. 4, no. 8, Aug. 1918, pp. 214-218. Arithmetical study of series of numbers which satisfy certain difference equations.

On the Representation of a Number as the Sum of Any Number of Squares, and in Particular of Five or Seven, G. H. Hardy. Proc. Nat. Academy of Sciences, vol. 4, no. 7, July 15, 1918, pp. 189-193. Research to deduce formulae for $s = 5$ and $s = 7$ from the theory of elliptic functions.

See also Electrical Engineering (Harmonics.)

MECHANICS

Beams

Distribution of Internal Work in Beams and Slabs, Henry T. Eddy. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 460-462, 1 fig. Difference in amounts of energy stored in steel indicates dissimilarity in structural functions of concrete.

Long Span Concrete Beams Should Have Fixed Ends, W. S. Tait. Eng. News-Rec., vol. 81, no. 8, Aug. 22, 1918, pp. 359-361, 5 figs. Method given by which computation of rigid frame may be readily made.

Maximum Positions of Moving Loads on Beams, F. K. E. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 31, 1 fig. Information for finding the maximum bending moments and shears on beams due to the action of loads moving over them. From a paper read before the Inst. of Local Government Engrs. of Australasia.

Columns and Struts

Discussion on Final Report of the Special Committee on Steel Columns and Struts, W. H. Burr and R. von Fabrice. Proc. Am. Soc. Civ. Engrs., vol. 44, no. 6, Aug. 1918, pp. 875-895, 4 figs. Comparison of committee's results with present practice. (Concluded.)

Disks, Rotating

The Strength of Rotating Disks, H. Haerle. Engineering, vol. 106, no. 2745, Aug. 9, 1918, pp. 131-134, 8 figs. A mathematical treatment applied to steam turbines.

Dynamics

The Fundamentals of Dynamics, W. S. Franklin and B. MacNutt. Science, vol. 48, no. 1231, Aug. 2, 1918, pp. 113-116. Criticism of Prof. E. V. Huntington's discussions of elementary mechanics in Mar. 3, 1916, issue.

Earth Pressures

Computing Lateral Pressure of Saturated Earth, A. G. Husted. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 441-442, 2 figs. Proposed method takes account of separation of hydrostatic from earth pressure, but allows full hydrostatic pressure.

Gyroscopic Phenomena

On Stability Phenomena in a Ship Gyroscope and Single Rail Railroads (Om Stabilitetsfaenomeneme ved Skibsgyroskopet og Enskinnebanen), A. Bendixsen. Ingenioren, vol. 27, no. 56, July 13, 1918, pp. 399-406, 5 figs.

Indeterminate Structures

Equivalent Uniform Loads for Indeterminate Structures, D. B. Steinman. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 231-232, 3 figs. Method worked out for ordinary trusses applied to curve influence lines; wheel-load complications avoided.

Truss Members

Effect of Initial Stress on Redundant Truss Members, H. T. Booth. Aviation, vol. 5, no. 2, Aug. 15, 1918, pp. 91-93, 3 figs. Equations for the calculation of load stresses in diagonal tension braces when an initial tension is present; example of the action when diagonals are similar; illustration of the stress calculation for redundant members, with initial tension in two of them.

See also Bridges (Stresses); Pipe (Curved Pipe.)

METAL ORES

Manganese

Manganese, M. A. Allen and G. M. Butler. Univ. of Ariz. Bul. no. 91, Min. Tech. Series, no. 19, Aug. 1918, 32 pp. Composition of manganese minerals—Psilomelane, pyrolusite, manganite, wad, braunite, rhodochrosite, rhodonite and alabandite; tests

for manganese; occurrence and origin of ores; Arizona deposits; uses; manufacture of alloys.

Radium

Radium Ore Deposits, Richard B. Moore. Eng. & Min. Jl., vol. 106, no. 9, Aug. 31, 1918, pp. 392-393. From paper before Colorado meeting of Am. Inst. of Min. Engrs., Sept. 1918.

Rare Metals

Rare Earths and Rare Minerals. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 78. Chief ores and uses of zirconium; method of refining graphite; preparation of ground mica.

Sulphur

Sulphur and Pyrites in 1917, Philip S. Smith. Am. Fertilizer, vol. 49, no. 4, Aug. 17, 1918, pp. 36-42 and 56-82. Production, imports, exports and character of domestic deposits of sulphur; qualities, uses, production and deposits of pyrites in the United States.

War Ores

War Materials of Colorado, A. H. Hubbell. Eng. & Min. Jl., vol. 106, no. 9, Aug. 31, 1918, pp. 382-384. Lead, zinc, gold, silver, tungsten and copper ores. Uranium, vanadium and radium produced from carnotite, vanadinite and pitchblende ores.

METAL-WORKING MACHINES

Drilling Spindles

A Vertical Slide and Drilling Spindle for the 2-in. Precision Lathe, C. H. C. Copeland. Model Engr., vol. 39, no. 898, July 11, 1918, pp. 19-21, 2 figs. Details of design.

Planers

Some New Ideas in Planer Practice. Woodworker, vol. 37, no. 6, Aug. 1918, pp. 26-27, 3 figs. Suggests advisability of shifting more of the feeding gear below the cutterhead so that it may pull the stock instead of pushing it, also slightly beveling the infeed edge of the bedplate under the cutterhead of single surfacers.

Portable Machines

Taking Machines to the Work, Edward K. Hammond. Machy., vol. 24, no. 12, Aug. 1918, pp. 1073-1081, 23 figs. Methods of applying portable machines in performance of shop operations, and advantages thus secured.

Presses

Ferracute Presses. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, p. 450, 1 fig. Description with dimensions and other data of a single-action power press recently redesigned by the Ferracute Machine Co., Bridgeton, N. J., adapted for cutting and forming sheet-metal work of large area, such as coal hods, metal shingles, etc.

Railway Shop

Machine Tools and Appliances in Railway Workshops. Ry. Gaz., vol. 29, no. 5, Aug. 2, 1918, pp. 134-138, 8 figs. Illustrates and describes improvements in designs and types effected during the last 50 years.

Shell-Drilling Machine

Special Shell-Drilling Machines, Donald A. Baker. Machy., vol. 24, no. 12, Aug. 1918, pp. 1131-1132, 4 figs.

Tool Slide

A Tool Slide for the Drummond 4-in. or Similar Lathe, W. Baker. Model Engr. & Electn., vol. 39, no. 899, July 18, 1918, pp. 29-31, 3 figs. Details of design.

Wheel-Forcing Machine

A New Wheel-Forcing Machine. Ry. Gaz., vol. 29, no. 4, July 26, 1918, p. 105. Product of Hollings & Guest, Birmingham, for removing heavy Foden and similar car wheels.

Wooden Dies

Using a Punch Press in Lieu of Bending Rolls, J. V. Hunter. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 243-245, 6 figs. Wooden dies and a punch press used to accomplish some awkward bending jobs.

See also Engineering Materials (Stellite.)

METALLURGY

Alloys

Some Miscellaneous Alloys Made by the Metal and Thermit Coöperation. Reactions, vol. 11, no. 2, Second Quarter 1918, pp. 29-30. Uses of phosphor copper, phosphor tin, manganese titanium, manganese boron, silicon copper, chromium copper, cobalt copper, nickel copper, vanadium copper, titanium copper and manganese aluminum.

Brass Rolling

Chemistry of the Brass Rolling Mill, or the Relation of the Chemical Laboratory to the Brass Rolling Mill, M. B. Karr. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 297-299. Significance of chemical control. Paper before Montreal Metallurgical Assn.

Rolling of Brass (Laminado del laton), J. Borrell Maciá. Revista Minera, year 69, no. 2645, June 24, 1918, pp. 309-313, 7 figs. Microstructure; composition of alloy for cold-rolling.

Non-Ferrous Alloys

Metallography Applied to Non-Ferrous Metals, Ernest J. Davis. Foundry, vol. 66, no. 313, Sept. 1918, pp. 427-429, 5 figs. Elementary article dealing with the science embracing a study of the internal structure of metals and alloys.

The Constitution and Influence of a Cored Dendritic Structure in Alloys, O. Smalley. Jl. Soc. Chem. Industry, vol. 37, no. 13, July 15, 1918, pp. 191T-200T and discussion 200T-201T, 22 figs. Genesis of microstructure; relation of composition and structure to physical properties; influence of varying casting temperature on properties of phosphor-bronze castings poured from the same melt; effect of heat treatment on properties of Admiralty gun metal; influence of impurities on properties of 70:30 brass before and after removal of the cast structure; relation of impurities to ghosts.

Stibnite Smelting

Blast-Furnace Smelting of Stibnite. Eng. & Min. Jl., vol. 106, no. 5, Aug. 3, 1918, pp. 211-210, 1 fig. Details of experimentation, showing effects of varying flux charge; minimum economic limit of coke required.

See also Electrical Engineering (Electrodeposition.)

MILITARY ENGINEERING

Anti-Aircraft Firing

The Problem of Anti-Aircraft Firing, X. Reille. Jl. Wash. Academy of Sci., vol. 8, no. 14, Aug. 19, 1918, pp. 465-480, 8 figs. Technical study of the general problems which anti-aircraft warfare has presented to the minds of artillerymen.

Artillery

Developments in Artillery During the War, J. Headlam. Sci. Am. Supp., vol. 85, no. 2215, June 15, 1918, pp. 370-371. How the changes in tactics affect technical matters and how the demands of the soldier may upset the plans of the scientist. (To be continued.)

Ballistics

Internal Ballistics, A. G. Hadcock. Proc. Royal Soc., vol. 94, no. A 663, July 1, 1918, pp. 479-509, 6 figs. Explanation and illustration of method for obtaining pressure-volume relation of gases in the bore of a gun from the instant of ignition of charge to the instant when shot leaves the gun, and mathematical expressions to plot the indicator diagram of charge when its nature and weight are known.

See also Building and Construction (Warehouse); Motor-Car Engineering (Ambulances); Roads and Pavements (Military Roads); Varia (Explosives.)

MINES AND MINING

Cementation

Cementation Process Applied to Mining, A. H. Krynauw. Colliery Guardian, vol. 116, no. 3005, Aug. 2, 1918, pp. 227-229, 9 figs. From paper before Chemical, Metallurgical & Min. Soc. of South Africa, May 1918.

Drilling

A Gasoline-Driven Diamond Drill Outfit, J. M. Longyear, Jr. Eng. & Min. Jl., vol. 106, no. 8, Aug. 24, 1918, pp. 343-345. Nearly 7,000 ft. of holes put down at a total cost of $2.152 per ft.; easily portable apparatus.

Fires

Mine Fire at Utah-Apex Mine, V. S. Rood and J. A. Norden. Safety Eng., vol. 35, no. 6, June 1918, pp. 356-364, 3 figs. Geology, mining methods and conditions of workings; conditions during and after the fire; results of analyses of air at different openings. Proc., A. I. M. E., Utah Section.

Some Results of Analysis of Airs from a Mine Fire, A. G. Blakeley and H. H. Reist. Jl. Indus. & Eng. Chem., vol. 10, no. 7, July 1, 1918, pp. 552-553. Data from samples taken at an anthracite coal mine generating a large quantity of methane.

Shafts

Shafts for Water Hoisting and Ventilation. Coal Age, vol. 14, no. 9, Aug. 29, 1918, pp. 397-400, 8 figs. "Water seal" permits shaft to be used for both ventilation and water hoisting. Description of first installation in United States.

Steel Guides in Shafts, J. Whitehouse. Jl. of South African Inst. of Engrs., vol. 16, no. 11, June 1918, pp. 200-204, 5 figs. Results obtained by the use of slotted steel guides in the turf shaft of the Village Deep Mine; suggested system for replacing guides.

Sprayers

Sprayer for Stone-Dusting in Mines, A. Rushton. Trans. Inst. Min. Engrs., vol. 55, part 3, July 1918, pp. 219-220, and discussion pp. 220-221. T-shaped wrought-iron tubing apparatus operated by compressed air.

Washing

Recuperation of Combustible from Slag and Wash Residium (Récupération du combustible utilisable dans les scories et résidus de lavage). L'Echo des Mines et de la Métallurgie, no. 2581, July 7, 1918. Treatment of slag from metallurgical furnaces; washing of schists from mining installations.

MOTOR-CAR ENGINEERING

Ambulances

U. S. A. Ambulance and Trailer. Automotive Industries, vol. 39, no. 4, July 25, 1918, pp. 152-155, pp. 148-149, 3 figs. Review of specifications for an ambulance body for the class A A or G. M. C. ¾-ton chassis. Details of the spare-parts trailer and field litter.

Headlights

Automobile Headlights and Glare-Reducing Devices, L. C. Potter. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 627-632, 13 figs. Discussion of underlying principles of causes of glares; devices to prevent glare.

Omnibus

Omnibus Selection by Tests. Tramway & Ry. World, vol. 44, no. 2, July 11, 1918, p. 39, 1 fig. Specifications of 19-30 passenger type supplied to San Francisco Council.

Piston Displacement

Piston Displacement Chart for Four-Cylinder Engines, Any Bore and Stroke. Motor Age, vol. 34, no. 9, Aug. 29, 1918, p. 38. Gives piston displacement in cubic inches with 0.04 cu. in. limit of error.

Tractors

An Improved Chain Track for Tractors. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, p. 280, 2 figs. Chain of sheet-steel sections having guided rocking joints with dust excluder and enclosed track carrier, developed by Ralph Wishon, of San Francisco, Cal.

Steering Creeper and Two-Wheeled Tractors, A. C. Woodbury. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, pp. 269-270, 2 figs. Outline of various plans for steering tractors by other methods than that involved in Ackermann steering axle.

The Latest Electric Tractor. Auto, vol. 33, no. 30, July 26, 1918, pp. 535-539, 2 figs. Three-wheeled couple-gear tractor designed to do the same work as a horse team at greater speeds.

The Peoria Kerosene Tractor. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, pp. 366-367, 4 figs. Assembled of parts produced in specialized plants. Engine, clutch and transmission bolted together. Drawbar hitch can be laterally adjusted from driver's seat.

Tractor Gear Ratio Chart. Automotive Industries, vol. 39, no. 9, Aug. 29, 1918, p. 372. Diagram of curves to find gear reduction to give a certain tractor speed with a given engine speed and drive-wheel diameter.

Tractor Speed in Plowing, Fred M. Loomis. Motor Age, vol. 34, no. 9, Aug. 29, 1918, pp. 5-8, 3 figs. Study of effect of speed and soil conditions on plow draft and tractor drawbar pull.

Trucks

English and American Motor Oil Tank Trucks, Frank C. Perkins. Gas Eng., vol. 20, no. 9, Sept. 1918, pp. 413-417, 11 figs. Data and descriptions of several types.

Wheels

Making Cast Steel Wheels for U. S. Army Trucks. Foundry, Vol. 66, no. 313, Sept. 1918, pp. 396-401, 11 figs. Description of processes at Dayton Steel Foundry Co.

Wood Wheels Preferred by the Majority, C. N. Bonbright. Auto. Topics, vol. 50, no. 11, July 20, 1918, pp. 1102-1103 and 1107. Discussion of merits of materials for automobile wheels.

See also Hoisting and Conveying (Trucks, Industrial.)

MUNITIONS

Ansaldo Munition Factory

Ansaldo Steel Plants Rush Munitions, Mario de Biasi. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, 4 pp., following 358, 12 figs. Gio. Ansaldo & Co., employing over 100,000 men, manufacture guns, cannon, shells, aeroplanes, submarines, merchant and battleships.

Bullets

Resistance of Copper Crushers During Compression, H. W. R. Mason. Arms & Explosives, vol. 26, no. 310, July 1, 1918, pp. 90-92. Description of tests and tables of results.

Cunard Shell Factory

The Cunard National Shell Factory. Engineering, vol. 106, no. 2740, July 5, 1918, pp. 3-6, 26 figs. Illustrated description of the work, the machines and tools used and certain fixtures.

Field Guns

The 75-Mm. Field Gun, Model 1916, M.III, Special Correspondence. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 323-328, 4 figs. Description of latest type of 75-mm. field gun built by U. S. Government.

Howitzers, 6-in., British

The British 6-in. Howitzer, I. William Chubb. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 231-242, 24 figs. First of a series on gun-making and repairing in English privately owned shops. Part II. in Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 411-423, 6 figs. Machining and heat-treating of jacket; assembling howitzer; fitting of new A-tubes and repair of damaged howitzers.

Madsen Automatic Gun

The Madsen Automatic Gun. Sci. Am. Supp., vol. 86, no. 2224, Aug. 17, 1918, pp. 108-110, 6 figs. Details of weapon for which great efficiency is claimed. From the Engineer (London).

Marine Torpedoes

Early History of the Marine Torpedo, H. H. Manchester. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, pp. 435-438, 11 figs. Historical sketch of prototype of modern torpedo, commencing with earliest known type, in 1285, and dealing with Bushnell's torpedo, 1810.

Naval Gun Cars

Gun Transport Car for the Navy. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 457-459, 4 figs. Details of special car for transporting 16-in. guns.

Special Cars for Transporting Heavy Naval Guns. Ry. Age, vol. 65, no. 5, Aug. 2, 1918, pp. 212-214, 4 figs. Details and drawings.

Revolvers

Revolvers and Automatic Pistols (Les revolvers et les pistolets automatiques), L. Cabanes. Génie Civil, vol. 73, no. 4, July 27, 1918, pp. 64-67, 10 figs. Recent developments in manufacture of French type, Nagant Russian and Austro-Hungarian no. 1898. (To be continued.)

Shell, 18-lb., British

Special Machine-Tool Fixtures for Making the British 18-lb. Shell, Chester B. Hamilton, Jr. Am. Mach., vol. 49, no. 9, Aug. 29, 1918, pp. 395-396, 5 figs.

See also Metal-Working Machines (Shell-Drilling Machine.)

PAINTS AND FINISHES

Ironwork

Corrosion of Ironwork, J. N. Friend. Surveyor, vol. 54, no. 1384, July 26, 1918, p. 43. Summary of results of author's researches on the usefulness of paint for protecting ironwork. Abstract of paper before Iron & Steel Inst. Also published in Can. Engr., vol. 35, no. 7, Aug. 15, 1918, p. 149.

Paint and Its Application to Railway Structures. Eng. Rev., vol. 32, no. 1, July 15, 1918, pp. 20-21. Preservative and decorative purposes of the industry. From report of Com. of Am. Ry. Bridge and Building Assn.

Standards for Protective Finishes for Iron, E. P. Later. Foundry, vol. 66, no. 313, Sept. 1918, pp. 424-426. Results of series of tests which indicate protective qualities of various metals and thickness of coatings.

(See also Mining Engineering (Corrosion).

PHYSICS

Air

Physics of the Air, W. J. Humphreys. Jl. Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 211-232, 5 figs. Rocket, ball, sheet, beaded, return and dark lightning; length of streak; nature of the discharge; temperature; visibility; spectrum; thunder; rumbling; cerannograph; chemical effects; explosive effects. (Continuation of serial).

Electrolytes

Colloidal Electrolytes: Soap Solutions as a Type, J. W. McBain. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 249 T-252 T. Results of experiments on the constitution, hydrolysis, conductivity, osmotic properties, and viscosity of soap solutions.

Electronic Frequency

Electronic Frequency and Atomic Number, Paul D. Foote. Phys. Rev., vol. 12, no. 2, Aug. 1918, pp. 115-121. Examination of Dr. Allen's formula for relation between atomic frequency and Moseley's atomic number, in the light of data on ionization potentials recently published by Franck, Davis, Bazzoni, Tate, Foote and Hughes.

Emulsions

Water-in-Oil Emulsions, A. U. Max Schlaepfer. Jl. Chem. Soc., vols. 113 and 114, no. 668, June 1918, pp. 522-526. Experiments performed with the aid of a finely divided solid, insoluble in both liquids, which is more easily wetted by the oil than by the water phase.

Flame Propagation in Gases

Flame Propagation in Gaseous Mixtures, G. A. Burrell and A. W. Ganger. Sci. & Art of Min., vol. 28, no. 26, July 27, 1918, p. 475. From technical paper 150 summarizing experiments of U. S. Bureau of Mines on limits of complete inflammability of mixtures of mine gases, etc.

Optics

On the Correction of Optical Surfaces, A. A. Michelson. Proc. Nat. Academy of Sciences, vol. 4, no. 7, July 15, 1918, pp. 211-212. Suggested modifications in Mr. Twyman's interferometer method.

Transmission of Light Through Water, S. L. E. Rose. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 577-578, 2 figs. Table of experimental values of transmission factor T in the equation $I = I_o \times T^f$ where I_o is the initial intensity and I the intensity after passing through f feet of water.

Polarization

Polarization in Case of Moving Electrodes, Carl Barus. Science, vol. 48, no. 1236, Sept. 6, 1918, pp. 253-254. Experiments at Brown University in which a strong residual polarization in direction of charging current was obtained; elucidation of phenomenon.

Reciprocity

Law of Reciprocity (Loi de réciprocité), J. B. Pomey. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 131-132. Equation derived from the principle of virtual velocities, between the electromotive force e_k in each of the branches of a network and the function of the derivative of the energy with respect to the current g_k; also reciprocal equation for the current in terms of the derivatives with respect to the electromotive forces.

Relativity

General Relativity Without the Equivalence Hypothesis, L. Silberstein. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no 211, July 1918, pp. 94-128. Chief aspects and illustrations of the physical implications of the principle of relativity as proposed by Einstein, but without placing gravitation in connection with the fundamental tensor which appears in the line-element of the world.

Spectra

Extreme Ultra-Violet Spectra of Hot Sparks in High Vacua, R. A. Millikan and R. A. Sawyer. Phys. Rev., vol. 12, no. 2, Aug. 1918, pp. 167-170, 1 fig. Report of experiments. Abstract of paper before New York Meeting, Am. Phys. Soc.

Structural Matter

On the Dynamics of the Electron, M. Nad Saha. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 76-87. Theory aiming at the formulation of the dynamics of the electron without following the preconceived ideas of classical mechanics. Reasoning is based on Lorentz's theorem of ponderomotive force and the principle of relativity.

Some Properties of Metals Under the Influence of Alpha Rays, A. G. McGougan. Phys. Rev., vol. 12, no. 2, Aug. 1918, pp. 122-129, 4 figs. Yale University experimental research involving: An attempt to present a fresh clean surface of metal to incident x-rays by scraping the surface of the metal while in a high vacuum; similar experiment for a surface of mercury by method of overflow, thereby stretching the surface film and producing a new clean surface of mercury.

Surface Friction

Surface Friction of Fluids, E. Parry. New Zealand Jl. of Sci. & Technology, vol. 1, no. 3, May 1918, pp. 154-156. Proposes as general law of fluid friction: For geometrically similar surfaces, $R/\rho v^2$ is a function of vl/u, where R is the resistance per unit of area, ρ the density of fluid, v the relative velocity, l a dimension of the surface, and u the kinematic viscosity; deductions from experimental data in regard to flow of water in pipes.

Vibrations

On Ship Waves, and on Waves in Deep Water Due to the Motion of Submerged Bodies, G. Green. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 48-63. Extension of Lord Kelvin's method for determining wave motion to any arbitrary conditions of applied surface pressure; discussion of the wave disturbance due to a cylinder and a sphere moving with constant velocity at a considerable depth beneath the surface.

Variably-Coupled Vibrations—Both Masses and Periods Unequal, E. H. Barton and H. M. Browning. Lond., Edinburgh & Dublin Phil. Mag., vol. 36, no. 211, July 1918, pp. 36-47. Theory of general case for double-cord pendulum and experimental results. (Continued from Oct. 1917 and Jan. 1918 issues.)

Vibration: Mechanical, Musical and Electrical. Nature, vol. 101, no. 2545, Aug. 8, 1918, pp. 456-459, 5 figs. Brass instruments and the low "F"; monochord vibrations; violin vibrations. (Concluded.)

See also Steel and Iron (Electric Resistance of Steel; Magnetic Properties of Steel.)

PIPE

Costs

Cost of Laying Iron Pipe. Mun. Jl., vol. 45, no. 6, Aug. 10, 1918, pp. 111-112. Unit figures for estimating cost under various conditions as to size, depth of trench and costs of material and labor.

Clay Pipe, Vitrified

The Use of Vitrified Clay Pipe for Irrigation Lines, V. E. Piollet. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 73-75. Requirements of construction.

Curved Pipe

Stresses in Curved Pipes, J. S. Henzell. Mech. World, vol. 64, no. 1646, July 19, 1918, pp. 28-29, 1 fig. Analytical study of the stresses in pipes which suffer external restraint. (Continuation of serial; preceding article published July 5.)

Joints

Methods of Making Sewer Pipe Joints. Contract Rec., vol. 32, no. 36, Sept. 4, 1918, pp. 718-719. Specifications for several joints. From discussion before Boston Soc. Civ. Engrs.

New Concrete Pipe Joint Designed for High Pressure. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, p. 216, 1 fig. Joint proves watertight under tests for heads up to 250 ft.; can be used for diameters as small as 4 in.

Pressure Pipe

Recent Developments in Reinforced Concrete Pressure Pipe for Water Supply Lines, W. R. Harris. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 58-59, 3 figs. Present

maximum working pressure; structural features; types of expansion joints.

The Choice of Material for Pressure Pipes, Ralph Bennett. Jl. of Electricity, vol. 41, no. 3, Aug. 1, 1918, pp. 123-124. Study of available types (steel, concrete, wood stave).

Welded Pipe

The Manufacture of Welded Pipe, S. A. Hand. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 285-288, 7 figs. Description of methods used by National Tube Co.

POWER GENERATION AND SELECTION

Aqueduct Construction

Construction of Famous Aqueduct Facilitated by Electricity, C. W. Geiger. Elec. Rev., vol. 73, no. 7, Aug. 17, 1918, pp. 241-242, 5 figs. Description of use of electricity in building the Los Angeles Aqueduct.

Auxiliaries, Drives for

Motor Driven Auxiliaries (I), C. Grant. Mech. World, vol. 63, no. 1641, June 14, 1918, p. 283. Comparison between turbine and electric-motor drives. (To be continued.)

Costs

Economic Proportion of Hydroelectric and Steam Power, Frank G. Baum, Proc. Am. Inst. Elec. Engrs., vol. 37, no. 9, Sept. 1918, pp. 1115-1119, 2 figs. Method for obtaining a curve showing "Total cost per kilowatt-year for hydroelectric and steam power" for any percentage combination of generation.

Electric Power Generation

A Review of Recent Electrical Engineering Progress, E. W. Rice, Jr. Elec. News, vol. 27, no. 16, Aug. 15, 1918, pp. 25-28. Efficiency in converting water to electric power; improvements in steam-producing devices; possibility of further advances in steam-turbo-electric unit; elements in the efficiency problem; linking of plants for exchange of power; electric furnace; electrification and transportation. Presidential address, A. I. E. E. convention.

Mills, Continuous

Operation of Motor-Driven Continuous Mills, H. C. Cronk. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 336-338. Operating data giving power consumption per ton, including auxiliary motors. Paper before Cleveland Section, Assn. Iron & Steel Elec. Engrs.

Mining

Electrical Manufacturers May Look to Metal Mining for Greater Output, W. A. Scott. Elec. Rev., vol. 73, no. 4, July 27, 1918, pp. 119-120, 3 figs. Present demand for metals creates increased mining activity; steadily widening field for electrical equipment and electric power in the metal mines.

Electricity in Coal Mining Operations, Frank Huskinson. Elec. Rev., vol. 73, nos. 7 and 8, Aug. 17 and 24, 1918, pp. 245-247, 8 figs., and 287-289, 6 figs. Mine haulage by electric locomotives; electric rotary drills, electric blasting; advantages of electric service.

How Electrical Methods Are Speeding Up Coal Mining Operations (III), T. R. Hay. Elec. Rec., vol. 24, no. 3, Sept. 1918, pp. 28-29, 8 figs. Details of manner in which electrical equipment is used inside and about the mine: electric mine hoists; pumping equipment; ventilating system; miscellaneous uses of electrical energy.

The Consideration of Items of Practical Importance in Connection with Mining Electrical Engineering, Chris. Jones. Proc. South Wales Inst. of Engrs., vol. 34, no. 2, July 19, 1918, pp. 159-206, 24 figs. Considerations, curves and data regarding the efficiency and cost of generating, distributing and applying electrical power in mines and kindred industries: periodicity of supply; power factor; earthed and insulated neutral; reactance; cables; transformers; earthing.

Tire Manufacture

Electricity in the Manufacture of Automobile Tires, B. B. Jackson. Elec. Rev., vol. 73, no. 4, July 27, 1918, pp. 121-124, 5 figs. Process of tire making; choices of motors and salient features of control, applying especially to plant of International India Rubber Co., South Bend, Ind.

Woodworking Machinery

Motor Drive for Woodworking Machinery, C. E. Clewell. Elec. World, vol. 72, no. 6, Aug. 10, 1918, pp. 253-256, 4 figs. Induction motors used extensively for timber sawing and planing; power requirements of typical machines; examples of successful motor applications.

POWER PLANTS

Rand Plant

Turbine House Plant Operation, wth Special Reference to the Rand Power Companies' Plants, T. G. Otley and V. Pickles. Trans. South African Inst. Elec. Engrs., vol. 9, part 5, May 1918, pp. 68-88, 11 figs. Discussion of some points in connection with efficient operation of turbine plant and its attendant auxiliaries.

Shaft Drive

More Power from Shaft by Use of Turbine. Elec. News, vol. 27, no. 15, Aug. 1, 1918, p. 33. General features of shaft drive, consisting of a low-pressure turbine and a Daubee reduction gear, recently installed in a Western Pennsylvania paper mill.

Small Power Plant

How to Manage Small Power Plants, W. T. Wardale. Model Engr. & Elecn., vol. 39, nos. 899 and 900, July 18 and 25, 1918, pp. 34-35, 2 figs, and pp. 47-48, 6 figs. Requirements of pump water gland packing; manner of packing. (Continuation of serial.)

Winona Plant

The New 5000-Kilowatt Station at Winona, Minn. Elec. Rev., vol. 73, no. 9, Aug. 31, 1918, pp. 321-324, 4 figs. Mechanical and electrical features of Wisconsin Railway, Light and Power Co.'s plant.

PRODUCER GAS AND GAS PRODUCERS

Suggestions for Gas Producer Operation, F. Denk. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 386-388, 5 figs. Tests and curves showing relations of factors influencing operation; depth and position of ash bed determined by unique device; careful attention essential in successful operation.

PUMPS

Air Lift

Performance of New Air-Lift Pumping Plant at Galesburg, Ill., J. Oliphant. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 57-58. Conditions of operation and results of tests.

Deep-Well Pump

Importance of Diameter of Deep Wells. Mun. Jl., vol. 45, no. 6, Aug. 10, 1918, pp. 105-107. Where deep-well pumps are used, diameter of well limits size of pump; lower part may be of smaller diameter.

Lift Pumps

Lift and Force Pumps, John H. Perry. Domestic Eng., vol. 84, no. 7, Aug. 17, 1918, pp. 239-241, 5 figs. Construction and operation of pumps with steady flow and high efficiency.

Mine Pump

Handling Mine Water, Henry E. Cole. Coal Age, vol. 14, no. 6, Aug. 8, 1918, pp. 264-266, 2 figs. Work pump must perform; character of water; types of pumps.

Turbine Pump

Pumping Equipment at Thorold, Ont., W. L. Adams. Can. Engr., vol. 35, no. 6, Aug. 8, 1918, pp. 121-122. New installation consisting of a two-stage 1500-gal. turbine pump directly connected to a 250-hp. induction motor, with control and auxiliary apparatus.

RAILROAD ENGINEERING, ELECTRIC

Circuit Breakers

High-Speed Circuit Breakers for Chicago, Milwaukee & St. Paul Electrification, C. H. Hill. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 623-626, 5 figs. Gives details of construction.

Electrification

Electrification of New York Connecting Railway. Ry. Gaz., vol. 29, no. 3, July 19, 1918, pp. 81-84. Method of operation; trolley supporting structures; catenary trolley system; communication lines; transmission lines.

Norfolk and Western Electrification Helping Directly to Win the War. Elec. Ry. Jl., vol. 52, no. 8, Aug. 24, 1918, pp. 322-325, 5 figs. Fifty per cent. increase in mountain-grade capacity through electrification.

Tendencies in Electrification, E. A. Palmer. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 176-178. Brief résumé of the leading steam railway electrification projects in the United States. From a paper before Pacific Coast Railway Club, June 1918.

The Electrification of the Chicago, Milwaukee & St. Paul Railway, A. E. du Pasquier. Trans. S. A. Inst. E. E., June 1918, pp. 94-126, 18 figs. Criticism of J. W. Kirkland's paper published in July and Aug. 1917 journals under same title; other railway electrification data in connection with Kirkland's inferences.

The Electrification of the Chicago, Milwaukee & St. Paul Ry., R. Beeuwkes. Elec. Ry. & Tramway Jl., vol. 39, no. 932, Aug. 9, 1918, pp. 42-46, 5 figs. Regeneration on down grades; engineering and construction; results of operation; comparison of train delays and of steam and electric locomotive performance. (Continued from July 12 issue.)

Heating of Cars

Why Not Use Wasted Energy to Help Heat Cars? Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 291-292, 2 figs. Possibilities of utilizing heat from car motors and resistance grids discussed and results of some tests given.

Line Construction

Applying Common-Sense in Line Construction, Charles R. Harte. Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 278-282, 14 figs. Money and time can be saved by close cooperation of designer and constructor, and by attention to details commonly overlooked.

Locomotive Control

A New Type of Mine Locomotive Control, L. W. Webb. Gen. Elec. Rev., vol. 21, no. 9, Sept. 1918, pp. 620-622, 8 figs. A controller developed for use on large mine locomotives where the capacity of hand-operated drum controls would be exceeded. Wiring connections of two-, three- and four-motor controllers.

Metering Power

Study of Car Energy Saving at Dubuque, L. E. Gould. Elec. Ry. Jl., vol. 52, no. 8, Aug. 24, 1918, pp. 334-336, 4 figs. Tests made on level and hill lines show that savings as high as 26 per cent. can be obtained by the use of meters as checking devices.

Operation

High Passenger Density the Outstanding Feature of New Service to Hog Island. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, pp. 404-408, 8 figs. Details and data of Philadelphia Rapid Transit Co.'s cars, including new features of door control.

Increased Economy Results from Correct Operation of Car Equipment, C. W. Squier. Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 275-277, 4 figs. Effects of various rates of acceleration and braking on the schedule speeds and power consumed; relation of number of stops and their length to cost of operation.

Selling Transportation on a Commercial Basis, Clarence Renshaw. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, pp. 415-416. Sale methods of other lines of business apply to electric railways; some requisites for good service.

Section Cars

Gasoline Motor Section Cars Decrease Labor and Cost of Track Maintenance, Clifford A. Elliott. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, p. 423, 3 figs. Maintenance-of-way department, Pacific Electric Rys., uses such cars and motor velocipedes in maintaining signals and tracks.

Single-Phase Locomotives

New Single-Phase Locomotives for the Swiss Bundesbahn, Hugo Studer. Elec. Ry. Jl., vol. 52, no. 10, Sept. 7, 1918, pp. 411-413, 8 figs. Description of four sample locomotives ordered for the Swiss Bundesbahn and several types developed by the Oerlikon Co. in connection with this electrification.

Track-Circuit Design

A Graphical Method of Solving D. C. Track-Circuit Problems, H. M. Proud. Ry. Engr., vol. 39, no. 463, Aug. 1918, pp. 157-159, 5 figs. Use of graphs showing total track conductance against volts on rails in finding volts on relay and train shunt. (Continuation of serial.)

Track Work

Special Track Work for Street Railways, J. V. Hunter. Am. Mach., vol. 49, no. 8, Aug. 22, 1918, pp. 335-338, 8 figs. Engineering work in connection with switches, frogs and crossovers.

RAILROAD ENGINEERING, STEAM

Bolsters, Truck

Design of Cast Steel Truck Bolsters. L. E. Endsley. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 152-154, 3 figs. States results in a bolster mast with no holes in side walls and subsequent results after holes were cut.

Brakes

A Mechanical Brake Control System for Railways. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 58-59, 7 figs. Descripton of details of "Reliostop" railway brake control system.

Air Brake Association in Fuel Saving. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 195-196. Recommendations tending to decrease leakage of brake pipes on freight trains in order to save 6,000,000 tons of coal annually. Report of committee.

Road Tests of the A. S. A. Brake. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 453-456, 4 figs. 100-car train run on Virginian with A. S. A. and Westinghouse brakes.

Tests of the Automatic Straight Air Brake on the Virginian Railway. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 244-247, 6 figs. Résumé of equipment, data and chronograph records of five positions of brake valve and of speed and stop distances.

Cars

Cars for Special and Excursion Traffic, Victorian Railways. Ry Engr., vol. 39, no. 463, Aug. 1918, pp. 160-161, 3 figs. Arrangement details of a pattern car, weighing 26 tons, with capacity for 82 passengers, recently completed at the Government railway shops at Newport, England.

High Capacity Cars on a Narrow Gauge Railway in India, Frederick C. Coleman. Ry. Age, vol. 65, no. 6, Aug. 9, 1918, pp. 265-266, 3 figs. Description of freight cars of the Sheffield & Twinberrow type for the Kalka-Simla Ry.

Crossings

Concrete Slab Railroad Crossings. Eng. & Cement World, vol. 13, no. 3, Aug. 1, 1918, p. 34. How they were placed at Cedar Rapids, Ia.

Freight House

Pennsylvania Completes Freight House at Chicago. Ry. Age, vol. 65, no. 5, Aug. 2, 1918, pp. 215-219, 8 figs. Description of new structure of two-level type.

Hot Boxes

The Hot Box Problem, N. Marple. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 196-198. Causes originating the hot box and suggestion to prevent them by making car owner responsible. Paper before Niagara Frontier Car Men's Assn.

Hump Yard

15,000-Car Hump Yard Near Chicago Planned by Illinois Central Railroad. Eng. News-Rec., vol. 81, no. 7, Aug. 15, 1918, pp. 313-316, 1 fig. Terminal for main-line trains, from which transfer trains will serve local yards, will have power-operated switches, motor-car service for car riders and L. C. L. transfer facilities for 450 cars daily.

Locomotive Boilers

Design and Maintenance of Locomotive Boilers. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 231-232. Application of autogenous welding to construction and renewal of smokeboxes, flues, staybolts, fireboxes and mud rings. Report of Committee on Design and Maintenance of Locomotive Boilers, before joint meeting of Master Car Builders and Master Mechanics Assns. Also published in Ry. Jl., vol. 24, no. 8, Aug. 1918, pp. 21-23.

Reducing Maintenance Costs on Locomotive Boilers, W. R. Toppan. Railroad Herald, vol. 22, no. 9, Aug. 1918, p. iv-A. How a terminal system cut down its flue and staybolt work following installation of a water-softening plant.

The Arrangement of Tubes in Locomotive Boilers, H. C. Webster. Mech. World, vol. 64, no. 1646, July 19, 1918, p. 33, 4 figs. Study of the arrangement necessary to secure maximum efficiency.

Locomotive Engines

Modern Locomotive Engine Design and Construction. Ry. Engr., vol. 39, no. 463, Aug. 1918, pp. 151-156, 8 figs. Locomotive feedwater heating systems, superheated steam and methods of superheating. (Continuation of serial.)

Locomotive Exhaust Nozzles

Locomotive Exhaust Nozzles. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 251-253, 2 figs. Study of part played by form of aperture in results obtained, based on physical character of phenomenon.

Locomotives

A Three-Cylinder Locomotive. Engineer, vol. 126, no. 3265, July 26, 1918, pp. 70-72, 10 figs. Illustrations and drawings, and special reference to the Gresley valve gear. Locomotive in operation on the Great Northern Ry., England.

New 3-cylinder Locomotive, Great Northern Railway, C. S. Lake. Model Engr., vol. 39, no. 897, July 4, 1918, pp. 1-5, 6 figs. Features of locomotive recently built at the Doncaster Works, England.

Compound Mallet for the N. & W. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, p. 263, 1 fig. Dimensions of 2-8-8-2 type.

N. & W. 267-ton Mallet Locomotive, H. W. Reynolds. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 445-450, 10 figs. Data, drawings and description of locomotive and its tender.

New Pacific and Mikado Type Locomotives for the Chicago, Burlington and Quincy Railroad. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 248-249, 2 figs. Dimensions of 4-6-2 and 2-8-2 types.

New 2-8-0 Type Locomotives for the Victorian Railways. Ry. Gaz., vol. 29, no. 2, July 12, 1918, pp. 51-52, 4 figs. Diagrams and dimensions.

First U. S. Standard Locomotive. Ry. Mech. Eng., vol. 92, no. 8, Aug. 1918, pp. 436-438, 5 figs. Description with drawings of the light Mikado type built by the Baldwin Locomotive Works.

The First of the U. S. Railroad Administration Locomotives. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 194-195. General features of Mikado (2-8-2) type recently completed by the Baldwin Locomotive Works.

Baldwin Locomotive Works Completes the First of the U. S. Standard Locomotives. Mikado type, 2-8-2, Assigned to the Baltimore and Ohio. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 239-240, 1 fig. Description and dimensions.

Small Locomotives of Special Types. Engineer, vol. 126, no. 3267, Aug. 9, 1918, pp. 111-112, 2 figs. Descriptions with dimensions and data of gasoline-driven locomotives of 20 and 40 hp., used at present for trench railways, but applicable for industrial railways of various types.

The Influence of Type on Locomotive Performance. Ry. Gaz., vol. 29, no. 4, July 26, 1918, pp. 108-112, 6 figs. Criticism of design for an engine of the 4-4-0 type proposed in April 12 issue, and table of comparative particulars of express locomotives of this type.

Mexican Railways

Serious Condition of the Railways in Mexico. Ry. Age, vol. 65, no. 7, Aug. 16, 1918, pp. 307-309. Report by Latin-American Division of Bureau of Foreign and Domestic Commerce.

Rail Failures

Derailment from Rail Failures Due to Transverse Fissures. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 190-192, 4 figs. Diagrams, micro-photos, and results of physical and chemical analyses of fractured rails. Report of Chief of Bureau of Safety, I. C. C., covering investigation of an accident which occurred on the Central of Ga.

Rail Renewing

Labor Saving Appliances in Rail Renewing on the C., B. & Q. R. R. Ry. Rev., vol. 63, no. 7, Aug. 17, 1918, pp. 229-233, 4 figs. Rail-laying machine, rail-drilling machine, tie-sawing machine.

Repair Shop

A Western Railroad Repair Shop. Frank A. Stanley. Am. Mach., vol. 49, no. 6, Aug. 8, 1918, pp. 249-252, 15 figs. Describing some methods and tools used.

Locomotive Repair Developments in Great Britain. Railroad Herald, vol. 22, no. 9, Aug. 1918, pp. 183-184. Construction details of Great Eastern Railway recently built. Special shops capable of carrying out repairs on between 40 to 50 engines simultaneously.

Running Repairs of Locomotive Boilers and Approved Methods of Wash-Out of Boilers. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 241-243, 6 figs. Data of mileage between washouts made by passenger and freight locomotives; cost of washing; methods and tools used.

Signaling

Electro-Pneumatic Interlocking Plants. H. A. Wallace. Ry. Signal Engr., vol. 11, no. 8, Aug. 1918, pp. 250-253. Details and operation of switches and signals; air valve; electro-pneumatic machine; "SS" system of signal control. Abstract of paper before Tex. Regional Committee of Ry. Signal Assn.

New Mechanical Plant on Chicago and Alton. Ry. Signal Engr., vol. 11, no. 8, Aug. 1918, pp. 239-243, 3 figs. Interlocker on a double-track main line crossing single-track road, designed not to require night leverman.

Track

Interesting Reconstruction Work on the Erie. Ry. Age, vol. 65, no. 6, Aug. 9, 1918, pp. 248-252, 9 figs. Work on a 35-mile section of double-track line in Indiana including some heavy grade revision.

Labor-Saving Devices for Track Maintenance. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 172-176. From a paper by E. Stimson before New England Railroad Club, May 1918.

Trans-Australian Railway

The Trans-Australian Railway. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 56-57, 1 map. Difficulties of construction; description of the route; progress of construction; special problems encountered; the country traversed.

Turntables

Construction, Care and Maintenance of Turntables. Ry. & Loco. Eng., vol. 31, no. 8, Aug. 1918, pp. 250-251, 2 figs. Features of improved types.

See also ***Cement and Concrete (Ties)***; *Factory Management (Railway Stores)*; *Labor (Railroad Employees)*; *Munitions (Naval Gun Cars.)*

REFRACTORIES

Testing and Inspection of Refractory Brick. C. E. Nesbitt and M. L. Bell. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 341-344, 8 figs. Results of tests on spalling (resistance to sudden thermal change), crushing and slag penetration; conclusion drawn from differences in the figures obtained. Paper before Am. Soc. Testing Materials.

See also Testing and Measurements (Refractories, Testing).

REFRIGERATION

Ammonia-Absorption Machines

Gas Formation in Ammonia Absorption Refrigerating Machines, Its Causes and Remedy. E. C. McKelvy and A. Isaacs. Am. Soc. Refrig. Engrs. Jl., vol. 4, no 5, March 1918, pp. 447-463, 1 fig. Report of experimental work undertaken by special committee to investigate nature and sources of gases by means of an experimental bomb consisting of a piece of 4-in. steel pipe closed at both ends by clamped blind flanges with a female recess. Read before Am. Soc. Refrig. Engrs.

Ammonia Conservation

Conservation of Ammonia and Coal. E. N. Fiedmann and Van R. H. Greene. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 268-269. Stuffing box and decomposition losses; temperature of cooling water and condenser pressure; saving coal; undesirable coal mixtures; increased evaporation. Paper before Long Island Ice Manufacturers' Assn.

Ammonia Leakage

Cost of Ammonia Leakage. Reactions, vol. 11, no. 2. Second Quarter 1918, pp. 31-36. Possibility of considerable loss of ammonia through apparently inconsiderable leaks.

Brine-Cooling System

The Practical Side of the Low Temperature Compression System. H. Solan. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 6, May 1918, pp. 549-556, 4 figs. Description of three installations operated with brine-cooling systems.

CO_2 Machines

Carbonic Acid Refrigerating Machines. J. C. Goosmann. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 272-274, 3 figs. Some conditions that have delayed general adoption of carbon-dioxide refrigerating machines; practical equality of three refrigerants; actual equality of horsepower required.

Cold Accumulators

Cold Accumulators and Their Application to the Refrigerating Industry. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 6, May 1918, pp. 541-548, 2 figs. Types of tanks and formulæ for calculations. Read before Milwaukee Section of A.S.R.E.

Hospital Refrigerating Plant

Service for the Sick. Power Plant Eng., vol. 22, no. 15, Aug. 1, 1918, pp. 605-610, 6 figs. Description of power plant at Blodgett

Memorial Hospital, Grand Rapids, Mich.; extensive refrigeration system.

Ice Making

Modern Stationary Can Raw Water Ice Plant. Ice & Refrigeration, vol. 55, no. 3, Sept. 1, 1918, pp. 75-84, 13 figs. Details of plans and complete equipment of plant; arrangement of engine, freezing and ice storage rooms; method of operation and details of cost; electrical equipment and cost of power.

Preventing Red Core. Louis Block. Ice & Refrig., vol. 54, no. 5, May 1918, pp. 270-271, 1 fig. Results of a discussion at a meeting of Refrig. Engrs.

Refrigeration and Ice Making. Charles L. Hubbard. Indus. Management, vol. 56, no. 2, Aug. 1918, pp. 105-109, 14 figs. Examples of apparatus and machinery used in military camps and on shipboard.

Treatment of Water for Raw Water Ice Making. M. F. Newman. Am. Soc. Refrig. Engrs. Jl., vol. 4, no. 6, May 1918, pp. 527-540. Account of different processes. Presented before the A.S.R.E.

Ice Structure

The Crystal Structure of Ice, A. St. John. Proc. of the Nat. Academy of Sciences, vol. 4, no. 7, July 15, 1918, pp. 193-197. Photographic spectrum investigation by means of a Coolidge tube with tungsten target excited by an induction coil with mercury turbine interrupter.

Insulating Materials

Report Upon Tests of Heat Insulating Materials for Cold Storage Rooms, W. M. Thornton. Cold Storage, vol. 21, no. 244, July 18, 1918, pp. 177-178. Method of testing; relative efficiency from total ice melted; quantity of heat transmitted.

Liquefaction of Gases

Argon, Lighting and Industries Employing Very Low Temperatures (L'argon, l'éclairage et l'industrie des basses températures), Georges Claude. Mémoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils de France, year 71, nos. 1-3, Jan.-Mar. 1918, pp. 66-72, 2 figs. Process of liquefaction of gases and description of apparatus for obtaining a liquid mixture of 75 to 80 per cent argon and the rest oxygen; argon and nitrogen in electric lamps.

Loss in Ammonia Manufacture

Sources of Loss During the Manufacture of Concentrated Ammonia Liquor. A. Marsden. Jl. Soc. Chem. Industry, vol. 37, no. 14, July 31, 1918, pp. 230T-232T. Suggestions to remedy sources of losses when making ammonia.

Salt Solutions

The Freezing Points of Concentrated Solutions and the Free Energy of Solution of Salts, W. H. Rodebush. Jl. Am. Chem. Soc., vol. 40, no. 8, Aug. 1918, pp. 1204-1213. Experimental determination of freezing-point-concentration curves for the commoner salt solutions; thermodynamic equations for the force energy of solution and examples of their application.

See also Drying (Low Temperature.)

RESEARCH

Factory Chemical Laboratory

Relation of the Chemical Laboratory to the Factory, M. B. Karr. Can. Mfr., vol. 38, no. 9, Sept. 1918, pp. 31-33, 3 figs. Before Montreal Metallurgical Assn.

Factory Research Laboratory

Planning a Research Laboratory for an Industry, C. E. K. Mees. Jl. Soc. Chem. Industry, pp. 201T-202T. Two possible forms of organization—"departmental" system and "cell" system. Abstract of paper before New York Section of Soc. Chem. Industry.

National Physical Laboratory

The National Physical Laboratory in 1917-18. Engineering, vol. 106, no. 2743, July 26, 1918, pp. 94-96. From the annual report, dealing with work of the various departments.

See also Testing and Measurements (Railroad Testing Laboratory.)

ROADS AND PAVEMENTS

Asphalt Roads

Asphalt Pavements, Chas. A. Mullen. Better Roads & Streets, vol. 8, no. 6, June 1918, pp. 225-229 and 252-253, 5 figs. Paper before Fifth Can. Good Roads Congress.

Procedure in the Construction and Maintenance of Kentucky Rock Asphalt Roads, S. O. Le Sueur. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 49-50. Characteristics and behavior of these roads; recommended specifications.

Concrete Roads

Build Permanent Pavements at New Aeronautical Station, Samuel H. Lea. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 447-449, 6 figs. Town-site roadways of concrete have sub-base throughout at Langley Field Station; special templet used for warped crown.

Concrete Road Construction During Freezing Temperatures. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 147-148. Sand, water and subgrade heated before mixing and laying concrete; concrete protected by a covering of canvas and hay.

Concrete Roads in New Zealand. Surveyor, vol. 54, no. 1383, July 19, 1918, p. 30. Methods of construction in Auckland City.

How to Get the Best Surface on a Concrete Road, A. H. Hunter. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 47-49. Remarks on the construction of forms, operation of templets, building of joints, finishing surfaces and use of the roller and belt.

Cost Keeping

Cost Keeping System for County Highway Work. Contract Rec., vol. 32, no. 34, Aug. 21, 1918, pp. 657-659. Elements applying to all cases. From paper before Wash. Assn. of County Engrs. Also published in Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 145-147.

Earth Roads

Method of Building Earth Roads in Kane County, Illinois, George N. Lamb. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 140-141, 4 figs. Laying out curves; standard cross-sections for grading; the operations; costs o fearth-road grading.

The Necessity of Engineering Supervision in Construction and Maintenance of Earth Roads, H. Ross Mackensie. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 155-157. From paper before Regina Branch of Can. Soc. of Civ. Engrs.

Easement Curves

Easing and Super-Elevating the Highway Curve. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 617-618. Table and diagram of super-elevations and offsets for easement curves, used by the highway engineers of King County, Wash., in construction of paved roads.

Frost Action

Impervious Bituminous Wall Suggested to Prevent Seepage Under Paving. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 226-228, 3 figs. Extensive study made of vertical movements of pavements with reference to frost action; distribution of moisture in clay and loam sub-grades and effect of walling off shown by charts.

Gravel Roads

Iowa Methods of Constructing Gravel Roads. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 247-248. From bulletin issued by Iowa Highway Commission.

Highways

Highway Carries Twelve Times as Much Local Freight as Railroad. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 224-226. Shipments by Baltimore road increase 480 per cent in year, saving railroads 39,923 ton-miles.

Notes on Highway Design, J. L. Harrison. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 237-238. Preliminary investigations; population benefited; volume of traffic; grades; distance; curvature.

Macadam Pavements

Method and Cost of Reducing Excessive Crown on a Macadam Pavement, E. Earl Glass. Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 144-145, 2 figs. Filling in sides of the road to reduce crown described.

Military Roads

Roads in Base Section of American Forces Require Widening and Resurfacing, Robert K. Tomlin, Jr. Eng. News-Rec., vol. 81, no. 8, Aug. 22, 1918, pp. 348-352, 8 figs. Heavy traffic by motor trucks and artillery on practice marches necessitates continuous maintenance.

Road Construction

Asphalt Resurfacing in Los Angeles, C. W. Geiger. Mun. Jl., vol. 45, no. 7, Aug. 17, 1918, pp. 123-125, 6 figs. Mixture for wearing surfaces and binder furnished by municipal asphalt plant. Surface heating method employed. All done by day labor.

Handling Materials on a Michigan Road Job. Municipal Jl., vol. 45, no. 10, Sept. 7, 1918, pp. 181-182, 6 figs. Gravel for concrete dredged from neighboring lake, transported, measured and mixed.

The "National" Pavement in New Haven. Mun. Jl., vol. 45, no. 8, Aug. 24, 1918, pp. 143-145. Methods used in resurfacing old macadam and brick pavements with a cover composed of about 18 per cent asphalt and 82 per cent pulverized earthy matter, 50 per cent of which passes through a 200-mesh sieve, and nothing being retained on a 10-mesh screen.

Road-Construction Machinery

The Use of Modern Machinery in County Road Construction, C. B. Scott. Good Roads, vol. 16, no. 9, Aug. 31, 1918, pp. 80 and 83. Various modern machines and devices; and new ways in which they are being used. Paper before North Carolina Good Roads Assn.

Sand-Clay Roads

Maintaining Sand-Clay Roads in North Carolina. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, p. 49. Account of investigation regarding failure of roads.

Tar Surfaces

English and American Practice in the Construction of Tar Surfaces and Pavements, A. H. Blanchard. Better Roads & Streets, vol. 8, no. 6, June 1918, pp. 230-234 and 253, 11 figs. Paper before Fifth Can. Good Roads Congress. Also published in Eng. & Contracting, vol. 50, no. 6, Aug. 7, 1918, pp. 142-144.

War Conditions

Policy of U. S. Highways Council Regarding Highway and Street Work During the War. Eng. & Contracting, vol. 50, no. 10, Sept. 4, 1918, pp. 232. Text of regulations, effective Sept. 10, 1918.

Road Building in Michigan Under War Conditions, Frank F. Rogers. Good Roads, vol. 16, no. 10, Sept. 7, 1918, pp. 89-90 and 92. Paper before Mich. State Good Roads Assn.

Water, Action of

The Action of Water on the Road Subgrade and Its Relation to Road Drainage, J. L. Harrison. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 50-52. Limitations of tile drainage; capillary attraction; heavy-clay soils; freezing of dry subgrades; cracking; use of Telford base; carrying capacity of subgrade.

See also Engineering Materials (Paving Blocks.)

SAFETY ENGINEERING

Acetylene

Report of the Department Committee on Cylinders for Dissolved Acetylene. Acetylene & Welding Jl., vol. 16, no. 177, June 1918, pp. 98-99. Results of experiments carried out at the Home Office Experimental Station, Eskmeals, Cumberland, with the object of ascertaining the result of igniting the acetylene in a pocket space formed in the porous material inside a cylinder, and the danger, if any, of such ignition. (Continuation of serial.)

Brick Making

Safety in Brick Making. Am. Industries (Accident Prevention Supp.), vol. 19, no. 1, Aug. 1918, 4 pp., 7 figs. Sketches of machines enclosed in standard guards.

Fires

Some Lessons from a Disastrous Carhouse Fire. Elec. Ry. Jl., vol. 52, no. 6, Aug. 10, 1918, pp. 239-241, 3 figs. Results of a fire caused by explosion of oil tank of a 44,000-volt lightning arrester.

Mine Rescue Stations

The Equipment and Organization of Mine Rescue Stations, A. J. Moorshead. Safety Eng., vol. 36, no. 1, July 1918, pp. 23-27. Prevention of accidents; necessary equipment and its care; first-aid supplies; exploring teams.

Scaffolding Construction

Safety in Scaffolding Construction. Building News, vol. 115, no. 3315, July 17, 1918, pp. 34-35. Reproduction of rules and regulations promulgated by the Department of Labor and Industry of the Pennsylvania Industrial Board.

Wood Alcohol

Wood Alcohol in War Time, Winifred Hathaway. Survey, vol. 40, no. 22, Aug. 31,

1918, pp. 609-611. Discusses unsuspected danger faced by thousands of workers in munition plants and elsewhere.

See also Hoisting and Conveying (Wire Ropes.)

SANITARY ENGINEERING

Air Checking of Sewer Pipe

Reducing Air Checking in Cooling Sewer Pipe, B. T. Sweely. Brick & Clay Rec., vol. 53, no. 4, Aug. 13, 1918, pp. 291-292. Procedure claimed to have reduced air checking 60 per cent. in middle-west plant.

Alum in Filters

The Selection of Alum for Filter Plants. Fire & Water Eng., vol. 64, no. 7, Aug. 14, 1918, p. 116. Extract of suggestions in annual report of Ontario Provincial Board of Health.

Sewage Disposal

Auto-Eductor Solves Sewage Tank Difficulty. Mun. Jl., vol. 45, no. 8, Aug. 24, 1918, pp. 145-146. Removal of large amount of greasy scum and sludge from septic tank that had resisted other pumping appliances.

Comparative Value of Activated Sludge and Sprinkling Filters, T. Chalkley Hatton. Contract Rec., vol. 32, no. 33, Aug. 14, 1918, pp. 638-641. Variation in standard effluent; area required for plants; loss of head and effect of temperature; clarification; odors; flies; disposal of sludge; cost of plants.

Design and Construction of the New Sewage Treatment Plant at Sedalia, Mo., R. E. McDonnell. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 71-73. Intercepting and grit chamber; Imhoff settling tanks; sludge-drying beds; sprinkling filters.

Design and Construction of Water and Sewerage Works at the Hog Island Shipyard, W. H. Blood. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 54-57. Difficulties met; purification plant; distribution system; hydrants; sewage pumping and treatment.

Design Details of Proposed Works for the Collection and Disposal of Sewage at Pottstown, Pa., C. E. Collins. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 61-64. Pumping station; settling tanks; dosing tank; filter; sludge-drying beds; capacity, operation and care.

Miles Acid Process May Require Aeration of Effluent, F. W. Mohlman. Eng. News-Rec., vol. 81, no. 5, Aug. 1, 1918, pp. 235-236, 1 fig. Experiments show that sulphur dioxide in effluent deoxygenates several volumes of diluting water.

Novel Sewerage System and Sewage Plant at Mt. Horeb, Wis., W. G. Kirchoffer. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, p. 61. Description of system made entirely of concrete.

Sewage Disposal, Edward Wilcox. Surveyor, vol. 54, no. 1386, Aug. 9, 1918, pp. 66-67. Presidential address, Assn. of Mgrs. of Sewage Disposal Works. (Concluded.)

Sewering an Army Cantonment. Mun. Jl., vol. 45, no. 8, Aug. 24, 1918, pp. 141-142. Construction work at Camp Bowie, Tex., done by the Gen. Construction Co., at a cost of $80,000.

Sprinkling Filter System and Auxiliaries Versus the Activated Sludge Process, T. Chalkley. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 67-70. Comparison as to standard effluent, area, loss of head, temperature, clarification, odors and cost.

The Deoxygenating Effect of the Effluent from the Miles Acid Process of Sewage Treatment, F. W. Mohlman. Eng. & Contracting, vol. 50, no. 7, Aug. 14, 1918, pp. 166-167, 1 fig. Concludes that the Miles acid effluent contains unoxidized sulphur dioxide which is oxidized at the expense of the dissolved oxygen in the water in which the effluent is diluted and that it may be oxidized before dilution by aeration for a short time with relatively small quantities of air.

Water-Purification Plants

Design and Construction of the New Water Purification Plant and Pumping Station at Checotah, Okla., V. V. Long. Mun. & County Eng., vol. 55, no. 2, Aug. 1918, pp. 70-71.

Mechanical Rapid Sand Filtration Plant for Dorval, P. Q. Contract Rec., vol. 32, no. 32, Aug. 7, 1918, pp. 615-617, 1 fig. Details of construction.

STANDARDS AND STANDARDIZATION

Inductance

Standard of Mutual Induction (Etalon d'induction mutuelle), M. A. Guillet. Jl. de Physique, vol. 7, Mar. Apr. 1917, pp. 75-87, 1 fig. Formula determining standard; theory and operation of apparatus. Presented before French Phys. Soc. (Continuation of serial.)

Screw Standards

Gaging Screws. H. J. Bingham Powell. Am. Mach., vol. 48, no. 25, June 20, 1918, pp. 1045-1046. Attempt to show way to correlate the numerous existing standards and to secure their interchangeability.

See also Aeronautics (International Aircraft Standards); Paints and Finishes; Railroad Engineering, Steam (Locomotives); Testing and Measurements (Gages.)

STEAM ENGINEERING

Boiler Code

Table of Allowances. F. R. Burlingame. Boiler Maker, vol. 18, no. 8, Aug. 1918, pp. 218-219, 1 fig. Figured from formulæ given in the revision of the A.S.M.E. Boiler Code published in January.

Corrosion

Surface Defects of Condenser Tubes Causing Corrosion. W. R. Webster. Page's Eng. Weekly, vol. 33, no. 724, July 26, 1918, p. 42. Abstract of paper before Am. Soc. for Testing Materials.

What Is the Cure for Condenser Tube Corrosion? Hartley LeH. Smith. Elec. Ry. Jl., vol. 52, no. 7, Aug. 17, 1918, pp. 283-285. Writer believes longer life will be secured from condenser tubes by proper selection of materials and care in manufacture, rather than by modification of conditions directly under control of operator.

Water Softening to Correct Boiler Corrosion. William Henry Hobbs. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 167-170. Prevention of incrustation, pitting and corrosion; reference to experiments to determine the relative corrosibility of various salts and manner in which these tendencies can be corrected.

Engine Economy

Improving Engine Economy. M. A. Saller. Power Plant Eng., vol. 22, no. 15, Aug. 1, 1918, pp. 617-620, 6 figs. Increasing capacity and efficiency of steam engines by proper valve setting, eliminating leakage and maintaining speed regulation.

Exhaust Steam

Utilization of Exhaust Steam for Generating Electrical Energy in Collieries. (Considérations sur l'utilisation des vapeurs d'échappement dans les houillères en vue de la production d'énergie électrique). A. Barjou. L'Industrie Electrique. Year 27, no. 627, Aug. 10, 1918, pp. 287-293, 7 figs. Utilization of exhaust steam; turbo-generator groups; types of turbines. (Continuation of serial.)

Lubrication, Engine Cylinder

Problems of Steam Cylinder Lubrication. W. F. Osborne. Blast Furnace & Steel Plant, vol. 6, nos. 8 and 9, Aug. and Sept. 1918, pp. 338-341 and p. 389. Importance and difficulties of lubrication; features influencing method of lubricating, such as the cylinder, the valves, steam flow and steam exhaustion.

Pipe Lines

Relation Between Loss of Pressure and Pipe Size in Long Steam Lines. H. Eisert. Jl. Engrs. Club of Baltimore, vol. 7, no. 6, Dec. 1918, pp. 103-122, 2 figs. Technical study based on Weisbach's formula for determining flow resistance of a fluid through a conduit of uniform cross-section.

Pumping Engines

Historical Data of Steam Pumping Engines, A. O. Doane. Fire & Water Eng., vol. 44, no. 9, Aug. 28, 1918, pp. 148-149. Comparison of various types in capacity and cost.

Two Newcomen Atmospheric Pumping Engines. Gerald T. Newbould. Colliery Guardian, vol. 116, no. 3005, Aug. 2, 1918, pp. 230-231, 3 figs. One built in 1787 and the other in 1823 are still in operation. From paper before Midland Inst. of Min., Civ. and Mech. Engrs. Also published in Iron & Coal Trades Rev., vol. 97, no. 2631, Aug. 2, 1918, pp. 118-119, 8 figs.

Steam Plants, Statistics on

Notes on the Development of the Use of Steam Since 1876. Robert M. Anderson. Stevens Indicator, vol. 35, no. 2, April 1918, pp. 97-107. Corliss engines, steam turbines, electric-power systems; statistics giving increase of various prime movers and electric motors during ten-year periods.

Turbine Theory

A New Theory of the Steam Turbine. Harold Medway Martin. Engineering, vol. 106, no. 2740, July 5, 1918, pp. 1-3, 1 chart. First of a series of articles; contains a steam chart based on Callender's tables and formulæ.

Turbines

Modern Steam Turbines. J. Humphrey. Iron & Coal Trades Rev., vol. 97, no. 2632, Aug. 9, 1918, pp. 147-148, 1 fig. A review of recent types.

New Turbine Plant at Hull. Tramway & Ry. World, vol. 44, no. 2, July 11, 1918, pp. 11-14, 8 figs. Installation of three-phase turbo-generating plant on scheme to augment existing high- and low-tension direct-current system.

Volcanic Steam Generation

Power from Volcanic Steam. Jl. Royal Soc. of Arts, vol. 66, no. 3429, Aug. 9, 1918, p. 602. Brief notes on Southwestern Tuscany plant where electric energy is obtained from low-pressure alternating turbines operated with volcanic steam.

See also Air Machinery (Turbo-Compressors); Engineering Materials (Boiler Plates); Marine Engineering (Turbo-Electric Propulsion); Railroad Engineering, Steam (Locomotive Boilers, Locomotive Engines, Locomotive-Exhaust Nozzles); Testing and Measurements (Steam, Quality of.)

STEEL AND IRON

Blast-Furnace Operation

Blast-Furnace Bears. J. E. Stead. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 9, 42 pp., 5 figs. Discussion of variable character of bear (mass of metal found below the hearth level of a blast furnace after it has been blown out); evidence of the existence of kish, sulphides of manganese and iron, cyano-nitrite of iron, titanium di-cyanide, oxides, silicates, phosphides and carbide crystals, and unique specimens, in the composition of some bears; hypotheses explaining their genesis.

Conserving Manganese in Steel Production. A. N. Diehl. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 366-367. Discussion read before Am. Iron & Steel Inst.

Copper Tuyeres for Blast-Furnaces. A. K. Reese. Proc. British Iron & Steel Inst., May 3-2, 1918, Paper no. 6, 6 pp., 3 figs. Details of design and adaptation.

Fuel Economy in Blast-Furnaces. T. C. Hutchison. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 5, 14 pp., 6 figs. Report of work done at the Skinningrove Iron Co.'s plant, consisting of two 8-ft. hearths and three 10-ft. hearth furnaces, and inferred observations on the importance of effectually cleaning the ironstone at the belt, the conditions that secure long life of furnace lining, and fuel economy. Also published in Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 118, pp. 378-380, 3 figs.

Inquiry on Blast-Furnace Practice in the United Kingdom. Proc. British Iron & Steel Inst., May 2-3, Paper no. 2, 19 pp. Effect of the mechanical and chemical conditions of raw materials on furnace working; influence of dimensions of the bell relative to stock line; use of double bells; size and quality of firebricks; use of waste gas for calcining ironstone. Report of committee summarizing answers received from owners of blast furnaces.

Principal Changes in Blast-Furnace Lines. J. G. West. Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 323-329, 29 figs. Bronze cooling plates inserted in brickwork; development of wider hearths; use of high blast temperatures; discussion of theoretical lines. From paper before Am. Iron & Steel Inst. (Concluded.)

Briquetting Iron Ores

Present Knowledge and Practice in Briquetting Iron Ores. Guy Barrett and T. B. Rogerson. Automotive Eng., vol. 3, no. 7, Aug. 1918, pp. 310-311, 1 fig. Methods followed and machines used in this work, with special reference to conditions in United States, England and Continental Europe. (Third of series.)

The Briquetting of Pulverable Iron Ore and Blast-Furnace Slime. (Le briquetage des minerais de fer pulvérulents et des poussiers de hauts fourneaux). G. Barrett and T. B. Rogerson. Génie Civil, vol. 73, no. 4, July 27, 1918, pp. 70-73. Collection of practical data. From a report before Iron and Steel Inst. (To be continued.)

Cast Iron

The Fluidity of Molten Cast Iron. Matthew Riddell. Foundry, vol. 66, no. 313, Sept. 1918, pp. 408-411, 1 fig. From a paper before British Foundrymen's Assn.

Chemical Constitution of Steel

Iron, Carbon aand Phosphorus. J. E. Stead. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 19, 24 pp., 23 figs. Account of experiments performed in order to investigate the effect of introducing carbon, by cementation, into homogeneous solid solutions of iron and phosphorus and temperature ranges in which free phosphide of iron passes in and out of solid solution in iron.

Non-Metallic Inclusions: Their Constitution and Occurrence in Steel. A. McCance. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper No. 14, 48 pp., 36 figs. Effect in strength of stressed material; position in relation to the ingot; etching reagents; influence of aluminum on sulphides; oxidation products of manganese sulphide; acid open-hearth slags and their reduction products; equilibrium conditions in liquid steel; results of analyses and examination of microphotographs of etchings.

Note on Inclusions in Steel and Ferrite Lines. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 13, 6 pp., 13 figs. Results of experiments which led the author to the conclusion that the phosphorus associated with non-metallic inclusions in steel leads to the formation of ferrite ghost lines.

Coke

The Importance of Coke Hardness. G. D. Cochrane. Proc. British Steel & Iron Inst., May 2-3, 1918, Paper no. 3, 11 pp., 3 figs. Results of experiments which led the author to establish as an axiom that the practical success of the working of a blast furnace is chiefly dependent on the mechanical condition of the coke used.

Cold-Working

The Effect of Cold-Work on the Divorce of Pearlite. J. H. Whiteley. Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 17, 9 pp., 14 figs. Investigation in the study of Eggertz color test for combined carbon consisting of experiments in which drillings of pearlitic steels were annealed in vacuo for about an hour at 650 deg. cent.; a small section of a hammered bar was heated in vacuo for periods of 15 min. at successive temperatures between 450 and 690 deg. cent., and finally a section of the hammered bar and a piece of the unstrained steel were heated together for 4 hr. at 600 deg. cent.

The Effects of Cold-Working on the Elastic Properties of Steel, J. O. Van Den Broek. Proc. British Iron & Steel Inst., May 2-3, 1918. Paper no. 18, 41 pp., 15 figs. Materials and apparatus; manner of conducting tests; measurements; discussion of data; effects of cold-stretching and cold-twisting; electric resistivity of cold-worked steel; effects on alloy steels; theory; microstructure; tests on steel balls; analysis of commercial process. Published also in Engineering, vol. 106, no. 2743, July 26, 1918, pp. 99-105, 15 figs.

Damascene Steel

Damascene Steel. N. Belaiew. Proc. British Iron & Steel Inst., May 2-3, Paper no. 20, 22 pp., 5 figs. History, external characteristics and three principal processes of manufacture; Anossoff's classification of patterns of damascene blades; author's analyses; explanation for ductility, malleability and elasticity of damascene alloys.

Electric Furnace Melting

Electric Cast Iron and Steel Manufacture (La production électrothermique des fontes et aciers), Jean Escard. Revue Générale des Sciences, year 29, no. 12, June 30, 1918, pp. 366-373, 4 figs. Héroult furnace; experiments of Sault-Sainte-Marie; California New-Héroult furnaces; Trollhattan electric furnace; Keller process.

Electric Furnace Production of Cast Iron and Steel (La production électrothermique des fontes et aciers), J. Escard. Revue Générale des Sciences, year 29, no. 13, July 15, 1918, pp. 401-413, 18 figs. Comparative study of five methods of manufacturing steel.

Electric Steel Production for Small Units, A. V. Farr. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 381-383, 6 figs. Description of cold-metal method predominating in electric-furnace units under 10-ton capacity; data on 6-ton Héroult furnace making high-carbon chrome steel. Paper before Am. Drop Forge Assn.

Metallurgical Electric Furnaces. Engineering, vol. 106, no. 2743, July 26, 1918, pp. 86-87, 8 figs. Electric steel-refining furnaces; features of control. From discussion by Faraday Society at Manchester, Feb. 1918.

Electric Steel, Franklin D. Jones. Machy., vol. 24, no. 12, Aug. 1918, pp. 1104-1110, 11 figs. Advantages of electric furnace; types and methods of operation.

Electric Resistance of Steel

Concerning the Constitution of Martensite in Low Carbon Steel and Its Influence on the Electrical Resistance (Hörande martensitens Konstitution vid lag Kolhalt ach dess inflytande pa elektriska ledningsmotstandet), C. Benedicks and E. Walldow. Bihang till Jern-Kontorets Annaler, vol. 19, no. 6, June 15, 1918.

Eutectic Alloys

Eutectic Alloys, Clifford W. Nash. Chem. Eng. & Min. Rev., vol. 10, no. 114, March 1918, pp. 161-166, 9 figs. Study in the structure of iron-carbon eutectic and eutectoid. (Concluded.)

Ferro Alloys

Carbon-free Ferro Tungsten, A. F. Braid. Reactions, vol. 11, no. 2, Second Quarter 1918, pp. 28-29. Uses of ferrotungsten and tungsten powder.

The Manufacture of Ferro Alloys in Colorado, Robert M. Keeney. Eng. & Min. Jl., vol. 106, no. 9, Aug. 31, 1918, pp. 405-409. From paper before Colorado meeting of Am. Inst. of Min. Engrs., Sept. 1918.

Ingots

Defects in Steel Ingots, J. N. Kilby. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 288-296, 13 figs. Previous conclusions upon influence of casting in relation to cracks in ingot or bar; composition of slags of different steel-making processes, their physical state, and relationship in ultimate product; basic open-hearth steel, with some reference to electric process. Abstract of papers before Sheffild Soc. of Engrs. and Staffordshire Iron & Steel Inst., coupled with further observations and results. Published also in Proc. British Iron & Steel Inst., May 2-3, 1918, Paper no. 12, 24 pp., 13 figs.

Magnetic Properties of Steel

Correlation of the Magnetic and Mechanical Properties of Steel, Chas. W. Burrows. Sci. Papers of the Bureau of Standards, no. 272, March 29, 1916, 208 pp., 42 figs. Relation of the magnetic to the other characteristics; magnetic behavior under influence of mechanical stresses greater and smaller than elastic limit; inhomogeneities and flaws; bibliography.

Development of Magnetic Susceptibility in Manganese Steel by Prolonged Heat Treatment, Charles F. Brush. Proc. Am. Phil. Soc., vol. 57, no. 4, 1918, pp. 344-353, 3 figs. Experiments performed on 19 bars, each 6 in. long and ½ in. in diameter.

Rolling Mills

Plate Production Expedites Shipbuilding, A. M. Staehle. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 361-365, 8 figs. Rolling-mill capacities increased 20 per cent and material saved by efficient plate specifications; many new plate mills built; description of Liberty Mill of Carnegie Steel Co.

Practical Pointers on Wire Rod Rolls, W. S. Standiford. Blast Furnace & Steel Plant, vol. 6, no. 9, Sept. 1918, pp. 367-369, 3 figs. Consideration of design of passes and roll trains; draft influenced by form of pass, structure of metal and degree of heat.

Producing Special Steel to Suit Specific Purposes. Can. Machy., vol. 20, no. 2, July 11, 1918, pp. 33-34, 9 figs. New strip mill at Massillon, Ohio.

New Installation for Rolling Alloy Strips, Blast Furnace & Steel Plant, vol. 6, no. 8, Aug. 1918, pp. 319-321. Departure in strip-mill practice by the Nat. Pressed Steel Co., Massillon, O.

The Slick Wheel Mill. Iron Age, vol. 102, no. 9, Aug. 29, 1918, pp. 491-498, 17 figs. Commercial products formed directly from large rolled bars by rolling-forging process at Cambria Steel Works.

Scrap Steel

Discard Steel. Steel & Metal Digest, vol. 8, no. 8, Aug. 1918, p. 474. Uses and properties of shell-discard steel.

See also Chemical Technology (Analysis, Steel); Testing and Measurements (Steel Testing).

TESTING AND MEASUREMENTS

Balloon Fabrics

See Permeability, below.

Carbon Dioxide Recorder

CO_2 Recorders in the Boiler House, John B. C. Kershaw. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 45-47, 10 figs. Boiler efficiencies and need for improvement; heat losses in the boiler plant and their control; seven types of automatic apparatus for recording CO_2 percentages described.

Clocks, Electric

Electrical Horology, H. R. Langman. Model Engr. & Elecn., vol. 39, no. 902, Aug. 8, pp. 72-77, 6 figs. Compilation of systems of electric clocks. (To be continued.)

Dynamometers

Commercial Dynamometers (IV), P. Field Foster. Mech. World, vol. 64, no. 1647, July 26, 1918, pp. 42-43, 4 figs. The rope-brake type invented by Lord Kelvin. (Continuation of serial.)

Elastic-Limit Recorder

An Improved Elastic Limit Recorder. Automotive Industries, vol. 39, no. 7, Aug. 15, 1918, p. 287, 1 fig. Attachment to a standard testing machine by means of which it is claimed one person can accurately determine the elastic limit of specimens both in tension and compression.

New Elastic Limit Recorder, J. L. Jones and C. H. Marshall. Iron Age, vol. 102, no. 7, Aug. 15, 1918, pp. 391-392, 2 figs. Sumner instrument enables tests to be made accurately and rapidly. From paper before Am. Soc. for Testing Materials, June 1918.

Electrical Measurements

A New Method of Measuring Alternating Currents and Electric Oscillations, I. Williams. Elecn., vol. 81, no. 12, July 19, 1918, pp. 253-255, 5 figs. Abstract of paper before Phys. Soc.

Fluid Gage

Coats Precision Fluid Gage. Am. Mach., vol. 49, no. 10, Sept. 5, 1918, p. 451, 1 fig. Data and description of a precision gage operating on the fluid principle, and used as a comparator, primarily, and not an actual measuring machine. Built by the Coats Machinery Co., Philadelphia, Pa.

Gages

Industrial Gages (Les calibres industriels), Ch-Ed. Guillaume. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 141-145, 1 fig. Evolution of length standards; joint action of International Bureau of Weights and Measures and Technical Section of the Artillery; temperature of definition; coefficients of expansion of several metals; standards; official resolutions.

Gloves, Rubber

Lineman's Rubber Gloves Under Test, F. C. Perkins. Wireless Age, vol. 5, no. 12, Sept. 1918, pp. 1038-1041, 2 figs. Method used by the Duquesne Light Co., Pittsburgh.

Hardness of Metals

A Law Governing the Resistance to Penetration of Metal When Tested by Impact with a 10 mm. Steel Ball; and a New Hardness Scale in Energy Units, C. A. Edwards. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 335-369, 9 figs. Experimental investigation from which author establishes as the law governing penetration resistance of plastic metals $d = C\ E^{0.35}$, where d = diameter of indent made by 10-mm. ball, C is a constant varying with hardness of metal, and E = total energy of impact.

Testing Hardness of Metals by the Boyelle-Morin Apparatus, C. J. Bowen Cooke. Jl. Inst. Mech. Engrs., no. 5, June 1918, pp. 331-333, 4 figs. Outfit and method of making a test.

Lubricants, Testing

Methods of Conducting Tests of Lubricants on Internal Combustion Engines. S. F. Lentz. Lubrication, vol. 5, no. 9, July 1918, pp. 4-9. Suggestions regarding extent to which local conditions should be considered in estimating importance of results obtained in tests.

The Testing of Lubricants, Raymond Francis Yates. Am. Mach., vol. 49, no. 7, Aug. 15, 1918, pp. 289-291, 3 figs. Explains various characteristics of lubricating oils and greases and how they may be tested with simple apparatus.

Meters, Electric

Demand Meters, J. A. Laubenstein. Gen. Elec. Rev., vol. 21, no. 8, Aug. 1918, pp. 573-576, 6 figs. Consideration of the actual measurement of "demand" and description of various types of meters designed for the purpose of determining the maximum demand rate of charge for power.

Effect of Daily Variations of Frequency on Reading of Induction Meters (Influence des variations journalières de la fréquence sur les indications des compteurs d'induction), M. A. Durand. Revue Générale de l'Electricité, vol. 4, no. 5, Aug. 3, 1918, pp. 136-140, 6 figs. Result of tests performed by Central Electrical Laboratory. From paper before French Society of Electricians.

Report of the Meter Committee. Elec. News, vol. 27, no. 13, July 1, 1918, pp. 45-48, 4 figs. Study of four methods for determining efficiently the power factor; account of recent changes in standard instruments Paper before Can. Elec. Assn.

Meters, Heat

Heat Meters (Les compteurs calorimétriques ou compteur de chaleur), R. Joëssel. Génie Civil, vol. 73, nos. 1 and 2, July 6 and 13, 1918, pp. 12-13 and 28-30, 3 figs. Résumé of work done to devise an instrument for measuring the amount of heat supplied to a fluid; applications and utility of this instrument. (Concluded.)

Moving Photomicrographs

How Moving Photomicrographs Are Taken. Iron Age, vol. 102, no. 6, Aug. 8, 1918, pp. 323-325, 10 figs. Apparatus for recording the gradual changes in a metal's structure when subjected to repeated bending stresses; possible applications.

Permeability

Determination of Permeability of Balloon Fabrics, J. D. Edwards. Aviation, vol. 5, no. 2, Aug. 15, 1918, pp. 103-106, 1 fig. Various methods for determining permeability to hydrogen; detailed description of method used at Bureau of Standards; discussion of phenomena of passage of gases through rubber by solution; data showing effect upon apparent permeability at different experimental conditions such as temperature, pressure, humidity of the gas, durations of test, etc.

Railroad Testing Laboratory

New Testing Laboratory, Southern Railway, Alexandria, Va. Ry. Rev., vol. 63, no. 5, Aug. 3, 1918, pp. 151-152, 3 figs. Brief description of laboratory and its equipment.

Refractories, Testing

Crushing Strength of Magnesia-Silica Mixtures at High Temperatures, O. L. Kowalke and O. A. Hougen. Iron & Steel Inst. of Canada, vol. 1, no. 7, Aug. 1918, pp. 300-304, 11 figs. Description of apparatus used; results of physical tests and microscopic examination.

Resonance Measurements

Resonance Measurements in Radio-Telegraphy with the Oscillating Audion, L. W. Austin. Jl. of Wash. Academy of Sci., vol. 8, no. 14, Aug. 19, 1918, pp. 498-500. Examples illustrating the procedure with the resonance click.

Specific Gravity Determination

Determining Specific Gravity of Viscous Tar, etc., at Different Temperatures, Renford Myhill. Gas Jl., vol. 143, no. 2882, Aug. 6, 1918, p. 254. Method used by writer.

Specific Heat

Calorimetric Determination of Curie's Point (Détermination calorimétrique du point de Curie). Jl. de Physique, vol. 7, March-April 1917, pp. 87-88. Method used by Weiss, Piccard and Carrard for measuring the mean specific heat C_m of ferromagnetic substances at temperatures between 16 deg. and 900 deg. cent.

Steam, Quality of

Testing the Quality of Steam, W. A. Taller. Mech. World, vol. 63, no. 1642, June 21, 1918, pp. 296-297, 1 fig. Effect of moisture in steam on turbine blades and on reciprocating-engine cylinders, also on lubrication; outline of two methods for determining percentage of moisture, by the throttling calorimeter and by weighing; formulæ for computations.

Steel Testing

Tests on Tie Bar from the Menai Suspension Bridge. Engineer, vol. 126, no. 3264, July 19, 1918, pp. 47-49, 3 figs. Report of the physical and metallurgical tests and the electrical resistance test.

Tanks, Measurements

Finding the Contents of a Horizontal Cylindrical Tank, Franz Szabo. Power, vol. 48, no. 8, Aug. 20, 1918, pp. 266-267, 1 fig. Gives alignment chart for the purpose.

Volumes of Cylindrical Tanks, M. W. Ward. Power, vol. 48, no. 5, July 30, 1918, pp. 159-160, 1 chart. Ready method of finding contents of a horizontal cylindrical tank with contents at any depth.

Tar

See Specific Gravity Determination, above.

Vacuum Determination

Production and Measurement of High Vacua, J. E. Shrader and R. G. Sherwood. Phys. Rev., vol. 12, no. 1, July 1918, pp. 70-80, 7 figs. Attempt to modify operation of the mercury diffusion pump and the Kundsen molecular gage and tests of the two machines used in combination.

Viscosimeter

The Standardization of the Saybolt Universal Viscosimeter, W. H. Herschel. Jl. of Franklin Inst., vol. 186, no. 2, Aug. 1918, pp. 243-245. Equations between absolute viscosity and density obtained by using standard Saybolt instruments. From Technical Paper no. 112 of the Bureau of Standards.

See also Aeronautics (Instruments); Varia (Moisture Ratio).

THERMODYNAMICS

Some Recent Studies in Heat Transmission, A. J. Wood. Am. Soc. Refrig. Engrs., Jl., vol. 4, no. 5, March 1918, pp. 464-506, 8 figs. Work of thermal testing plant of Pennsylvania State College planned to include: Determination for various common materials of internal conduction (C) and combined coefficient (K) of convection and radiation as affected by velocity, humidity, difference of temperature and condition of surface; separation of this combined coefficient into its two factors, radiation and convection; deduction of laws which can be readily applied by heating and refrigerating engineers to building construction, including both simple and compound walls. Presented at annual meeting of Am. Soc. Refrig. Engrs.

TIMBER AND WOOD

Wood Grain

The Grain of Wood with Special Reference to the Direction to the Fibres, A. Koehler. Aerial Age, vol. 7, no. 22, Aug. 12, 1918, 12 figs. Influence of direction of grain on strength of timber; rules to determine direction and slope of fibers.

TRANSPORTATION

Marine Terminals

Marine Terminals for Inland River Cities Located on High Ground, H. McL. Harding. Int. Mar. Eng., vol. 23, no. 8, Aug. 1918, pp. 479-481, 7 figs. Principles governing construction of efficient river terminals; design and equipment; mechanical coördination between water and rail.

VARIA

Tractors Rough-Level Lands Before Sale to Settlers. Eng. News-Rec., vol. 81, no. 10, Sept. 5, 1918, pp. 438-439, 4 figs. Reclamation engineers get costs of putting acreage on as favorable conditions as units first entered upon.

Colored Photography

Dufay Colored Photography (El procedimiento versicolor Dufay para la fotografiá en colores). Boletin de la Sociedad de Fomento Fabril, year 35, no. 4, Apr. 1918, pp. 177-180, 6 figs. Successive operations in manufacture of films for colored photos.

Copper Statistics

The Future of Copper, W. F. Staunton. Min. & Oil Bul., vol. 4, no. 9, Aug. 1918, pp. 371-373, 3 figs. Chart showing world production for 28 years and considerations of the needs of industry.

Diamonds

Formation of Diamonds (La formation du diamant), Ch. A. Parsons. Revue Générale des Sciences, year 29, no. 11, June 15, 1918, pp. 327-333. Survey of systematic researches of the origin of diamonds and considerations on possibility of arriving at a definite conclusion in this question.

Engineering Societies

Centralized Activities of U. S. National Engineering Societies, Alfred D. Flinn. Can. Engr., vol. 35, no. 7, Aug. 15, 1918, pp. 151-154. Exposition of United States conditions to Canadian engineers.

Explosives

Science of Quarrying Rock with Explosives. Du Pont Mag., vol. 9, no. 2, Aug. 1918, pp. 4-8, 4 figs. Different ways of making blasts; suggestions and remarks.

Tunnel-Blasting at Chuquicamata, E. E. Baker. Western Eng., vol. 9, no. 9, Sept. 1918, pp. 366-372, 5 figs. Blasting for steam-shovel work in bench about 180 ft. high.

Filters

Filter Adjustments at Packard Mill at Rochester, Nevada, F. Dean Bradley. Eng. & Min. Jl., vol. 106, no. 5, Aug. 3, 1918, pp. 207-209, 3 figs. A mechanical sampler and a mixer for repulping the tails were added to the filter, the number of nozzles increased and a nozzle constructed for spraying wash solutions.

Moisture Ratio

Moisture Ratio, A. Smith. Aerial Age, vol. 48, no. 1228, July 12, 1918, pp. 48-49. Remarks on H. A. Noyes' article on Reporting Moisture Results, Science, vol. 47, no. 1212, p. 293, and Bul. no. 107, Bureau of Chemistry, Official Methods of Analysis, compiled by the Association of Official Agricultural Chemistry.

Public Utilities

Cost Versus Value of Service in Rate Making, John Bauer. Elec. World, vol. 72, no. 9, Aug. 31, 1918, pp. 388-389. Discussion of fundamental purposes and factors that must be considered in general system of public utility control; charging what the traffic will bear; popularity of cost rates.

Salvage

The Admiralty Salvage Section. Engineering, vol. 106, no. 2740, July 5, 1918, pp. 16-17, 2 figs. Description of some of the work of this section of British Navy.

Time Zones

Proposed New Boundaries for Standard Time Zones, Emerson W. Judd. Ry. Age, vol. 65, no. 5, Aug. 2, 1918, pp. 209-211, 1 fig. Elaborate and ingenious plan for relieving all large cities of the double time standard.

WOOD

(See Timber and Wood)

WOODWORKING MACHINES

Band Saw

Vertical Log Band Saw. Engineering, vol. 106, no. 2745, Aug. 9, 1918, p. 146, 1 fig. Description and principal data of a vertical log band saw made by A. Ransome & Co., Ltd.

Propeller-Shaping Machine

Aero-Propeller Shaping Machine. Engineer, vol. 126, no. 3264, July 19, 1918, p. 60, 2 figs. Description of a machine for shaping aero propellers made by A. Ransome & Co., Ltd., Newark-on-Trent.

See also Power Generation and Selection (Wood-Working Machinery.)

ACCESSIONS TO THE LIBRARY

BITUMINOUS COAL BEDS IN WEST VIRGINIA, FIGURE SHOWING. Compiled and revised to date. July 1, 1918. Purchase.

BLASTERS' HANDBOOK. *Wilmington, 1918.* Gift of E. I. du Pont de Nemours & Co.

BOOK REPAIR AND RESTORATION. By M. S. Buck. *Philadelphia, 1918.* Purchase.

CAPITAL ISSUES COMMITTEE RULES AND REGULATIONS. *New York, 1918.* Gift of Guaranty Trust Company.

CARNEGIE INSTITUTE. FOUNDERS' DAY, 1918. *Pittsburgh, 1918.* Gift of Carnegie Institute.

CARNEGIE LIBRARY OF PITTSBURGH. CASE HARDENING. (Reprinted from the Monthly Bulletin, March, 1918). *Pittsburgh, 1918.* Gift of Carnegie Library of Pittsburgh.

CONCRETE AND CEMENT. A list of books in the Brooklyn Public Library. *Brooklyn, 1918.* Gift of Brooklyn Public Library.

CONCRETE CONSTRUCTION, articles on, Portland Cement Association. Magazine list, May, 1918. Gift of Association.

DEAF MUTES IN THE UNITED STATES. Analysis of the Census of 1910. *Washington, 1918.* Gift of U. S. Bureau of the Census.

ELECTRIC RAILROAD. A potential factor in relieving freight congestion. (Reprint from Electric Railway Journal, May 11, 1918.) Gift of American Electric Railway Association.

ENEMY SUBMARINE. (Bulletin No. 2, 1918. Naval Consulting Board.) *New York, 1918.* Gift of Naval Consulting Board.

FEDERAL VALUATION OF THE RAILROADS IN THE UNITED STATES. Statement prepared by Thomas W. Hulme, Vice Chairman, of the developments in connection with Federal valuation as of July 1, 1918. Gift of Clemens Herschel.

FRENCH-ENGLISH MILITARY TECHNICAL DICTIONARY, with a supplement containing recent military and technical terms. By C. DeWitt Willcox. *New York, 1917.* Purchase.

FUEL FACTS, August 1, 1918. Gift of U. S. Fuel Administration.

GENERAL THEORY OF BRIDGE CONSTRUCTION. By Herman Haupt. *New York, 1856.* Gift of John T. Whistler.

GREAT BRITAIN. Department of Scientific and Industrial Research. Report on the sources and production of iron and other metalliferous ores used in the iron and steel industry. *London, 1918.*

——— Report of the Committee of the Privy Council, 1915-16, 1916-17. *London, 1916-17.*

——— Report of the Fuel Research Board on their scheme of research and on the establishment of a fuel research station. *London, 1917.*

——— Industrial research in the United States of America. (Science and Industry, No. 1.) *London, 1917.* Gift of Great Britain Department of Scientific and Industrial Research.

HARRISBURG (PA.) ENGINEERS' COMMISSION. Report. 1916. *Harrisburg, 1916.* Gift of Charles Whiting Baker.

MCGRAW ELECTRICAL TRADE DIRECTORY. Railway Edition. 1918. *New York, 1918.* Gift of McGraw-Hill Company.

MAGNETIC FLUX DISTRIBUTION IN ANNULAR STEEL LAMINAE. By A. E. Kennelly and P. L. Alger. (Bulletin No. 16.) Gift of Massachusetts Institute of Technology, Electrical Engineering Department.

MAXIMUM BASE PRICES, DIFFERENTIALS AND EXTRAS ON IRON, STEEL AND NONFERROUS PRODUCTS, FIXED DIRECT BY THE GOVERNMENT AND THROUGH RECOMMENDATION OF AMERICAN IRON AND STEEL INSTITUTE. *Cleveland, 1918.* Gift of Penton Publishing Company.

METALLURGICAL STUDY OF THE STEEL BASE AS RELATED TO GALVANIZING. By G. A. White. *Buffalo, n. d.* Gift of Matthews-Northrup Works.

MINERAL PRODUCTION OF CANADA DURING THE CALENDAR YEAR 1916. Annual Report. *Ottawa, 1918.* Purchase.

MINING ENGINEERS' HANDBOOK. By Robert Peele. *New York, 1918.* Purchase.

MOODY'S MANUAL OF RAILROADS AND CORPORATION SECURITIES. Volume III. Industrial Section, 1918. *New York, 1918.* Purchase.

NATONAL BOARD OF FIRE UNDERWRITERS. Electrical Data, July, 1918.

——— List of inspected electrical appliances, April, 1918. *Chicago, 1918.* Gift of National Board of Fire Underwriters.

THE NECESSITY FOR GOVERNMENT CONTROL OF THE OIL INDUSTRY. By M. L. Requa. Address delivered July 22, 1918. Gift of U. S. Fuel Administration.

PRACTICAL TREATISE ON LIMES, HYDRAULIC CEMENTS AND MORTARS. By Q. A. Gillmore. *New York, 1863.* Gift of John T. Whistler.

PROFIT SHARING, ITS PRINCIPLES AND PRACTICE. By A. W. Burritt and others. *New York, 1918.* Purchase.

RED CROSS INSTITUTE FOR CRIPPLED AND DISABLED MEN. Provision for vocational reeducation of disabled soldiers in France. Publication No. 14.

——— Provision for war cripples in Germany. Publication No. 13.

——— Provision for war cripples in Italy. Publication No. 12. Gift of Red Cross Institute for Crippled and Disabled Men.

RHODE ISLAND. Department of Forestry. Forest Fire Tactics. By Jesse B. Mowry. *Pawtucket, R. I., 1918.* Gift of Rhode Island Commissioner of Forestry.

SANITARY SUGGESTIONS REGARDING THE LOCATION, CONSTRUCTION AND MANAGEMENT OF PUBLIC BATHING BEACHES. By H. A. Whittaker. (Reprint from *The Journal Lancet*, June 15, 1918.) Gift of author.

PORTLAND CEMENT ASSOCIATION. Magazine List, July, 1918. Gift of Association.

STONE & WEBSTER ENGINEERING CORPORATION. Steam Power Stations, Ed. 2. *New York, n. d.*

——— Gas Plant Construction, Coal and Water Gas Generating Systems. *New York, n. d.* Gift of Stone & Webster Engineering Corporation.

TECHNICAL ASSOCIATION PAPERS, being the address and papers delivered before the Technical Association of the Pulp and Paper Industry, Feb. 6-7, 1918. *New York, 1918.* Gift of Technical Association of the Pulp and Paper Industry.

UNIVERSIDAD NACIONAL DE LA PLATA. Anuario para el Año 1914. *La Plata, 1914.*

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YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1918. *London, 1918.* Purchase.

GIFT OF J. PARKER B. FISKE.

A House of Brick for $10,000. *Boston, 1910.*
One Hundred Bungalows. *Boston, 1912.*
Tapestry Brickwork. No. 11-F.
Tapestry Brick Fireplaces. 1913. (Catalogue No. 23.)
Tapestry Brick and Tilework for Floors and Interior Walls. No. 29, 1913.
Through the Home of Tapestry Brick. No. 28, 1913.
Cost of a House. A comparison between brick, wood, cement and hollow block construction. By J. P. B. Fiske.
"Fisklock" "Tapestry" Brick. No. 33A.

GIFT OF W. F. B. ROUQUETTE.

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